MILITARY MEAT *and* DAIRY HYGIENE

PREPARED UNDER THE DIRECTION
OF THE
SURGEON GENERAL
OF THE
UNITED STATES ARMY

Compiled by
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DEDICATED

To the memory of Major George A. Lytle, Veterinary Corps, for his work in establishing the Veterinary Meat and Dairy Hygiene Service of the United States Army

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INTRODUCTION

This publication is prepared for the information of the personnel of the veterinary and sanitary services of the Medical Department, Army of the United States in performing the professional details of examining food products of animal origin in accordance with Army Regulations. Such examinations wherever conducted, at point of production, at time of purchase, while in storage, during shipment, upon receipt or at issue at any point in the United States or elsewhere, are essentially hygienic in nature for the protection of the health of troops. Veterinary and medical officers should become intimately acquainted with the commercial production of edible products of animal origin including commercial specifications and procedures, and with all purchase requirements of procurement authorities as obtain. For information concerning reports and returns required in connection with the veterinary meat and dairy hygiene service, reference should be made to Army Regulations.

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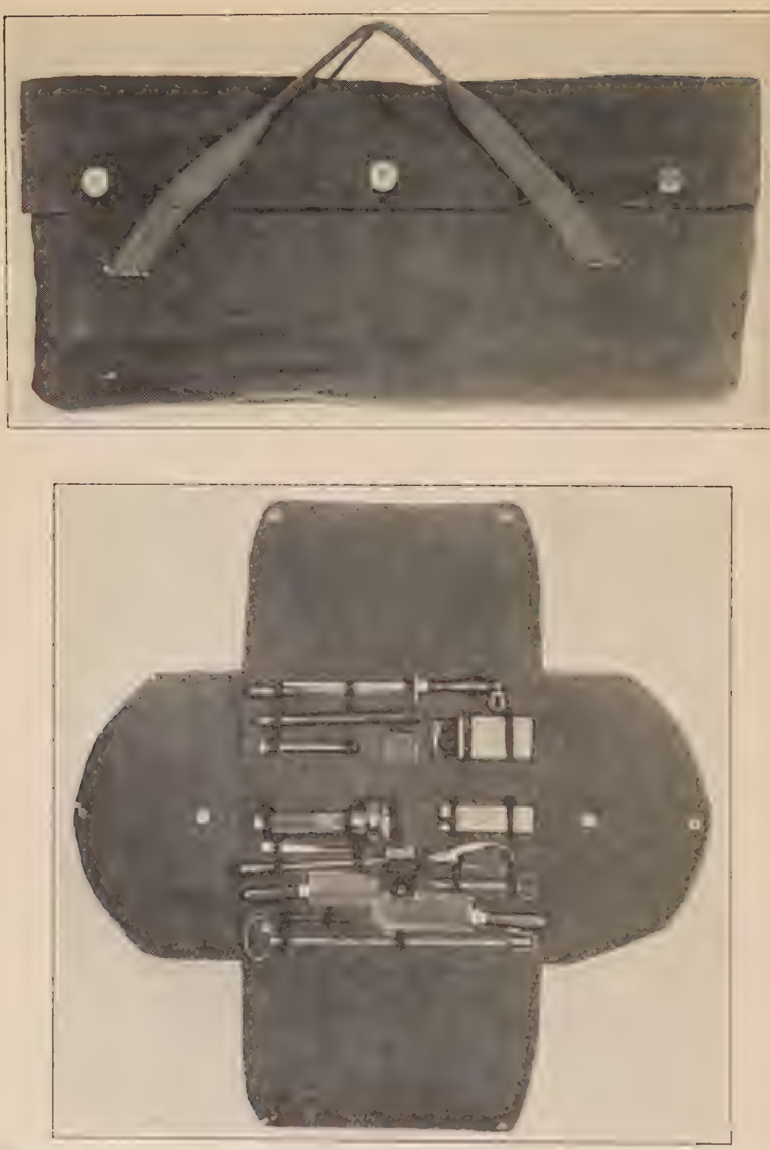

FIG. 1 VETERINARY MEAT AND DAIRY INSPECTION CASE, UNITED STATES ARMY

Upper. Case closed.

Lower. Case opened, showing sharpening steel, meat triers, dairy thermometer, branding ink container, magnifying glass, inking pad, notebook, flash light, sharpening stone, tenaculum, inspection stamp, can-opener, post-mortem knives, butter and cheese trier, clinical thermometer and lard trier.

1 S G
C. of C. P.
2 U. Service by Vet. - assists surgeon
a by S G.
Vet. commands rest

CHAPTER I

General Provisions

A. ADMINISTRATION

The Veterinary Service of the Army is administered, under the direction of the Surgeon General, by an officer of the Medical Department, who is selected by the Surgeon General and assigned to duty in his office as Chief of the Veterinary Division.

The Veterinary Service of a department, corps area, post, camp, or other station, or of an army, corps, division, or other unit, is conducted by the senior veterinary officer on duty, whose official designation is the veterinarian. The Veterinary Service, as a part of the Medical Department activities of the command, is supervised by the surgeon and in his staff relations the veterinarian is the assistant of the surgeon, who in turn is the representative of the Medical Department on the staff of the commander concerned.

At all military stations and in the field the veterinarian commands and administers the veterinary detachment, or other veterinary unit, and exercises those functions separate and apart from the administration of the Medical Department units employed on medical service.

In the absence of a veterinary officer, the surgeon is directly responsible for the Veterinary Service, including its administration; provided that competent veterinary assistants, enlisted or civilian, have been assigned him.

B. RESPONSIBILITY FOR CONDUCTING

The Veterinary Service with humans, i.e., that phase concerned with the examination of food supplies, is entirely a matter of sanitation and is a direct extension of the sanitary service of the Medical Department, which is charged with responsibility in all matters concerning the protection of the health of the troops.

The veterinary service as a part of the Medical Department is charged with duties and responsibilities concerned with all food supplies of troops that are of animal origin including an investigation into the sanitary origin, soundness of quality and sanitary condition of

meats and meat food and dairy products prior to and at time of purchase, while in storage and at issue; the sanitary condition of establishments, storehouses, freezers, refrigerators, refrigerating space in cars and ships and other places in which such supplies are manufactured, handled, stored, shipped, or issued; the sanitary condition of dairies and milk herds supplying troops; and for making recommendations with reference thereto, and with the instruction of veterinary personnel in the performance of the foregoing duties. The necessary information is obtained through the operation of the veterinary inspection procedures prescribed in appropriate Army Regulations. Such inspections of these supplies as to quantity and compliance with specifications are made at time of purchase or such other times as may be required by purchasing officers.

C. OBJECT

The veterinary meat and dairy hygiene service is essentially hygienic and sanitary in its nature. Its purpose is to protect the health of the troops by preventing the purchase or issue of meat and dairy products which by reason of their source, nature, handling, or condition may be unsafe or unsuitable for food purposes. The supervision thereof exercised by the surgeon of a station or command is intended to coordinate the technical duties performed by veterinary personnel with the other general requirements of the sanitary service in order that the whole may function most effectively without duplication of effort or lost motion in attaining the main objective of protecting the health.

D. RELATION TO PURCHASE, RECEIPT AND ISSUE OF SUPPLIES

Insofar as this service deals with the purchase, receipt, and issue of designated food supplies by purchasing and issuing officers, it is closely involved with the responsibility of such officers that such supplies as they may handle shall comply with the specifications under which they are purchased, received, or issued. Purchasing and issuing officers are necessarily dependent for expert advice on veterinary personnel making inspections, and full coöperation by such personnel is enjoined with a view to adequately protecting the financial interests of the Government.

The defects to be looked for, both sanitary and in specification requirements, are usually detected in the same veterinary inspection. No inspection for specification requirements is contemplated which

does not include simultaneously an investigation of sanitary conditions, and the two inspections overlap and blend in essential features. Nevertheless, sanitary inspections are more comprehensive and must be applied repeatedly to the same products in order to insure the continuance of the conditions found to be correct when the supplies were originally procured. Sanitary inspections of supplies therefore are required while they are in storage, or when they are shipped, issued, or sold, when the question of specification requirements is not under consideration; and the same is true of sanitary inspections required to be made of establishments and dairies as hereinafter described.

E. RELATION TO FEDERAL AND OTHER OFFICIAL INSPECTION AGENCIES

The Federal meat inspection act provides for the inspection of meats intended for interstate shipment by the Department of Agriculture, and the larger part of such supplies purchased for the Army is inspected and passed by this agency insofar as concerns ante- and post-mortem examinations, and, at times, other inspection procedures. It is the function of the veterinary service not to duplicate this work, but as an Army agency to take over the inspection of supplies purchased or offered for purchase, accepting the findings of the Department of Agriculture so far as they go and completing for the Army the inspection to the point of issue to troops. With reference to food supplies not intended for interstate shipment, such as are slaughtered and sold within a state or outside the territorial United States or in the field and in other places where the Federal meat inspection act is nonapplicable, the fitness of such supplies may depend entirely on the inspection of the Army veterinary service, unless a competent state or municipal inspection is maintained. The veterinary service, therefore, in its duty of protecting solely the interests of the Army, continues the inspection procedures of authorized Federal, state, or municipal agencies, accepting those deemed competent, supplementing them where they are incomplete or entirely absent, and repeating them, only when they are manifestly indequate or incompetent.

F. SCOPE OF INSPECTIONS

Information concerning the condition of food supplies of animal origin is obtained through veterinary or medical sanitary inspections of establishments including carriers, and in an examination of the

foods as outlined under chapter VII, and live food animals, beginning at the source of origin or the first point of contact with the military service and ending with their issue to troops or other disposition. Inspection of food supplies is further subdivided as inspections prior to purchase, inspection at receipt, inspection during transportation, inspection during storage, and inspection at issue to troops or other disposition.

1. Inspections Prior to Purchase. The inspections prior to purchase include antemortem and postmortem examinations of food animals; inspections during manufacture, including handling and shipment; or when supplies are offered for sale to organizations, as messes, or to the Government at purchasing points, at stations or in the field.

2. Inspection at Receipt. The inspection on receipt is the inspection made when and where the supplies are acquired or accepted, either at purchase by a purchasing officer or by the troops directly, or by shipment from a supply officer to a storage or issue point and is maintained at purchasing points, at stations or in the field.

3. Inspection During Transportation. The inspection during transportation is the examination made of food supplies at time of loading into, and unloading from vehicles, cars, boats or other carriers and includes sanitation of carrier, soundness of products, their proper conservation and other required factors. Supplies requiring interstate or foreign shipment from United States should comply with all rules of the Department of Agriculture applicable to civilian dealers and shippers.

4. Inspection During Storage. By the term inspection during storage is meant the inspection of food supplies subsequent to their procurement or acceptance and prior to their issue or prior to shipment from one station to another. These supplies by reason of their tendency to undergo deterioration and harmful changes, rendering them in part or in whole unfit for food purposes, should be examined at intervals from the time of their receipt at a storage place. All such inspections are of the nature of reinspections of the extent and thoroughness required by existing conditions. Inspection in storage is practically limited to the service at supply depots and at stations.

The inspection of surplus stores the sale of which to the public is contemplated is a special procedure. The supplies may require interstate shipment and the rules of the Department of Agriculture applicable to civilian shippers and dealers in like cases must be complied with in all respects.

5. Inspection at Issue to Troops or Other Disposition. The inspection at issue to troops is the final veterinary inspection given food supplies at or shortly before their issue, is essentially for soundness, and pertains entirely to the service of stations and in the field. It is similar to the inspection during storage, but is more detailed and takes into consideration the fact that the supplies have reached the point of ultimate disposal. So far as practicable, it is a piece inspection. Food supplies disposed of otherwise than by issue to troops should be given a veterinary sanitary piece inspection.

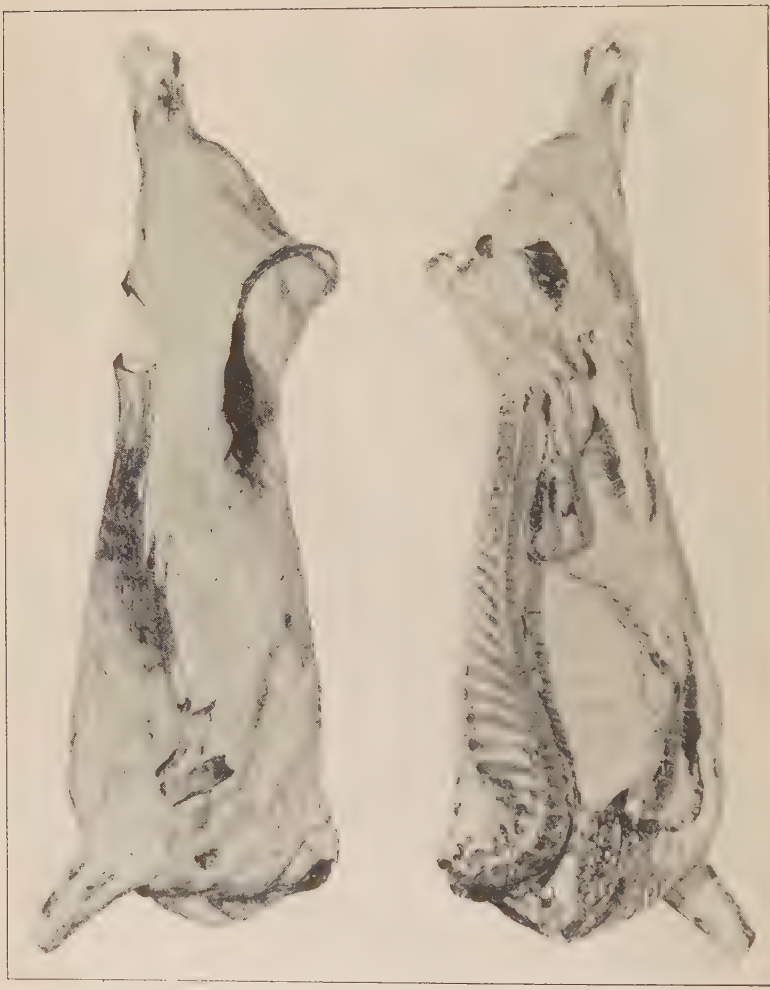

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FIG. 2. PRIME STEER CARCASS

CHAPTER II

Station Service

A. VETERINARY PERSONNEL

The veterinarian of a camp, post, depot, purchasing point, or other station or separate command is charged with making the veterinary inspections pertaining to meat and dairy hygiene; with making suitable recommendations as to the acceptance or rejection of meats and meat food and dairy products, the disposal of rejected supplies and the suitability of the various sources of supply; and with preparing the prescribed records and reports.

The veterinarian of a depot (reserve, intermediate, or general area) under the officer in charge, conducts the veterinary service thereof as defined and prescribed for a station veterinarian so far as the requirements for a veterinary service at such depots conform to those of a station, and renders the same reports and returns. He supervises the veterinary service at subdepots and purchasing points operating under the jurisdiction of the depot commander.

The veterinary detachment at a depot includes all personnel assigned to veterinary duties and reporting to the officer in charge. Officers and enlisted men on detached service at subdepots and purchasing points under the jurisdiction of the depot, belong to the depot detachment.

When no veterinary officer is available for assignment to a station because of its small size or for other reasons, a specially qualified and instructed noncommissioned officer may be assigned thereto for veterinary duties, including meat and dairy hygiene, reporting directly to the surgeon. In this event the station surgeon prepares and submits the routine reports and returns pertaining to the veterinary service unless otherwise specifically prescribed.

In the absence of all veterinary personnel from a station, the station surgeon represents the Medical Department in veterinary matters, utilizing such facilities as may be at his disposal. He also keeps the commanding officer advised as to the veterinary needs of the station.

B. SCOPE OF MEAT AND DAIRY HYGIENE SERVICE

The meat and dairy hygiene service of a station or command includes the inspection of meats and meat food and dairy products received and issued by the quartermaster or purchased from local butchers and dealers; of the sources from which these supplies are obtained; and of the dairy herds and farms from which the milk supply is obtained.

In general terms, these inspections, as regards supplies, consist of the examination of elementary food products of animal origin at the place of production, purchase, receipt, or issue to troops. It is contemplated that they shall apply, so far as practicable, to all meats and meat food and dairy products received by a command or any part of it.

1. Station Order. In the larger commands, the service is most efficiently provided for by the issue of a station order, as outlined in chapter VIII, paragraph 8-e, covering all products of animal origin.

2. Sanitary Service. The inspection of company kitchens, messes, or refrigerators for the purpose of examining food products which have already passed the designated veterinary inspection at time of receipt at the station or at issue, the supervision of the fresh-milk supply after the milk leaves the charge of the dairyman, and the inspection of ice-cream factories, restaurants, and eating places are duties which pertain more specifically to the general sanitary service than to the definitely technical functions of the veterinary service.

3. Examinations for Soundness. The inspection and reinspection of the meats and meat food and dairy products received and issued at the local commissary cover soundness, and are made by the veterinarian at the time of delivery to the quartermaster, at or shortly before issue and as frequently in the interval between receipt and issue as their condition requires. In connection with these inspections and reinspections, the sanitary condition of refrigerators and other storage rooms are observed and reported. The adaptability and cleanliness of vehicles used for transporting such supplies and the methods of handling up to the point of delivery to organizations also receive like attention.

4. Examinations for Compliance with Specifications. Simultaneously the veterinarian maintains such inspection for compliance with Government specifications as may be required by the quartermaster. The station veterinarian should ascertain these requirements and, with the approval of the commanding officer, see that adequate veterinary personnel for meat-inspection duty is available at such times and

places as will meet the needs of the quartermaster. With the approval of the commanding officer, the veterinarian renders such reports as the quartermaster may desire or may be directed by his superiors to submit.

5. Inspections, General. The institution of Army veterinary meat and dairy hygiene inspection in local establishments; antemortem, postmortem and products inspection; relation to other official inspection agencies; and the correction of defects in establishments as discussed under 8-f, chapter VIII, generally are applicable for all products of animal origin coming under station veterinary service.

6. Action. When defects are discovered in any product of animal origin, action should be taken along the same lines as outlined under 8-h, chapter VIII, and as specifically required by Army Regulations. Some of these requirements are discussed in succeeding chapters.

7. Station Dairy Farm Inspection. The station veterinarian should make an initial investigation of all dairies, dairy farms, collecting depots and creameries, and the herds of those dealers proposing to supply milk to troops and should make in writing to the commanding officer such recommendations as are deemed proper regarding their suitability as a source of supply. Subsequent inspections of approved milk establishments, in accordance with Army Regulations and as discussed under chapter XVII, should be made at least once every month, and should the veterinary officer consider it advisable for any sanitary reason to discontinue a source of supply, he should so recommend in writing to the commanding officer, through the surgeon, giving a full statement of the sanitary defects and the efforts which have been made to correct them.

Multiplicity of dairies, distance of dairies from the station, or lack of transportation are not reasons for failure to inspect, unless their number and distance render inspection practically impossible with the personnel and transportation available. Such conditions warrant a recommendation that the products of such dealers be excluded from the command.

The veterinary officers should remember that in connection with inspections made outside of a military reservation he may make recommendations for changes which he may find necessary, but that military authority competent to direct such corrective measures usually is lacking. Would the owner or manager of an establishment or dairy at any time not permit of a proper inspection or fails to comply with the reasonable and necessary veterinary requirements specified, the

veterinary officer then should recommend to the commanding officer the exclusion of the products thereof from the command.

Occasions may arise when a more or less unsatisfactory supply must be accepted if the article in question is to be obtained at all. Likewise supplies derived from extensive or widely scattered sources, of which the Army consumes a relatively small part, may result in a situation wherein veterinary inspection at the source is manifestly impracticable and recommendations based on such inspections would in any event receive scant consideration from the civilian operators. In each case the station veterinarian in meeting inspection requirements should carefully consider all the various factors entering into the situation. Coöperation by civilians can often be obtained through the use of tact and good judgment. Frequently much reliance must be placed on the character of Federal, State, and municipal inspections; and the veterinary officer should keep in close touch with the officials making such inspections and be familiar at all times with the standards which they maintain. In any event the object should be to obtain the highest possible degree of correct sanitation under existing circumstances.

8. Pasteurization. The sanitary examination of pasteurizing depots supplying fresh milk to troops is considered as part of the duties of the sanitary service of a command (see chapter XVII); however, it should be borne in mind that pasteurization should not be accepted as a substitute for dairy farm inspection, as the hygienic condition of milk depends largely upon the conditions existing at the source of supply. Insanitary milk due to contamination at the source is thereafter correctible only in part; hence it is important that the milk shall come from healthy cows and that it shall be handled in a sanitary manner.

Efficient pasteurization has undoubted value in lowering numerical bacterial counts but it is only a partial remedy for contamination at the source; therefore pasteurization of a milk supply in no wise relieves the veterinary service from the necessity for inspection at the source. Laboratory reports of the bacterial count of milk samples may guide the veterinary officer in determining whether or not a particular dairy shall be recommended as an approved source of milk supply, and it is desirable that samples of milk be collected at the dairy and bacterial counts made to aid in determining sanitary conditions at that point, but bacterial counts of milk samples taken after delivery to the station can not be considered as meeting dairy inspection requirements.

9. *Depot Service.* At depots charged with the procurement, storage and shipment of products of animal origin, the veterinary service is specially concerned with making the sanitary inspections pertaining to the meat and dairy hygiene of the station as discussed above and with such inspections for specification requirements as may be required by the officer in charge. This service is specialized, and veterinary personnel is assigned with due regard for its technical qualifications in order that the dual object of protecting the health of troops and animals through the procurement of sound and wholesome supplies, and of protecting the financial interests of the Government by ensuring that supplies purchased are in compliance with specification requirements, may be accomplished most effectively.

The veterinarian of a depot should arrange to provide adequate personal supervision over veterinary personnel at subdepots and purchasing points as often as occasion requires.

(*Permission United States Bureau of Agricultural Economics*)

FIG. 3. CHOICE STEER CARCASS

CHAPTER III

Sanitary Inspection of Establishments

A. DEFINITION AND OBJECT

1. Establishment. The term establishment as used herein includes cars, boats, vehicles, yards, pens, abattoirs, slaughtering houses, dairy farms and other places in which cattle, calves, sheep, goats, swine, poultry, fish or other food producing animals are maintained, fattened, transported or slaughtered; packing houses, coolers, freezers, butcher shops, markets, curing compartments, smoke houses, canneries, rendering plants, poultry plants, egg rooms, fish houses, milk collecting depots, creameries, pasteurizing depots; ice cream, condensed milk, powdered milk, malted milk, butter, cheese, sausage or other factories or plants; store houses and storage places of every kind, including installations and equipment thereof, in which carcasses of such animals, parts, trimmings or products derived therefrom, or other products of animal origin, are processed, manufactured, prepared, packed, handled, or stored, and from which they are shipped or issued to troops; also refrigerating and other cars, refrigerating or other space in ships, trucks, wagons and other vehicles or carriers in which carcasses, parts or products are transported.

The inspection of pasteurizing depots, ice cream factories, eating places, and store rooms and refrigerators containing products which have been issued to troops, is considered as coming under the general sanitary service of a command.

The veterinary inspection of establishments consists of the sanitary investigation of the location, type, construction, repair, condition, equipment and operation of establishments and all parts thereof; also of the personnel and products, and the freedom from vermin or other objectionable agencies. It pertains to the veterinary service at purchasing points, at stations and in the field.

The inspection of establishments proceeds simultaneously with and forms an integral part of the ante-mortem, post-mortem, and products inspection procedures wherever in operation. Indeed, the most thorough inspection of food supplies may be nullified by failure

to correct insanitary conditions under which they are handled; consequently it is essential that the veterinary officer be thoroughly familiar with conditions bearing on the source and handling of the supplies upon which he is required to pass. In connection with the inspection procedures pertaining to inspection prior to purchase, it is of special importance that observation and investigation of the sanitary condition of abattoirs, packing houses, etc., shall proceed side by side with the inspection of the supplies. It is likewise essential that food supplies in storage be kept under correct sanitary conditions until issued in order to avoid harmful deterioration or loss.

B. INSPECTION PROCEDURE

The sanitary inspection of dairy farms, milk collecting depots, creameries and pasteurizing depots is considered in chapter XVII. Special sanitary inspection procedures relating to other establishments are discussed under appropriate chapters. The general sanitary conditions of establishments which require investigation and corrective action include the following:

1. *Premises.* Suitability of site and surroundings, including cleanliness, drainage, and freedom from nuisances.

2. *Receiving Facilities.* Adequacy, suitability, cleanliness, water supply and drainage of pens, isolation pens, sheds, runways and unloading chutes. Suitability of location, construction and state of repair of receiving and loading docks.

3. *Interior Construction of Buildings.* Suitability of construction and state of repair of interiors of all rooms or compartments, etc., with special reference to floors and gutters, the arrangements for drainage and the disposal of wastes, and the arrangement and adequacy of the rooms and compartments for the purposes assigned.

4. *Ventilation.* System and efficiency of ventilation of all rooms and compartments as shown by the absence of moisture and odors.

5. *Lighting.* System and adequacy of lighting, both artificial and natural.

6. *Water Supply; Ice; Plumbing.* Source, storage, quality, quantity, and distribution of water; source and quality of ice; suitability and repair of plumbing installations.

7. *Equipment and Utensils.* Adequacy, suitability, and repair of equipment and utensils used in any part of the establishment. Note condition of special equipment as scalding vat, scraping machine,

viscera chutes, vats, and other facilities for washing, drying, and trimming carcasses, pickle vats, boxes, churns, etc.

8. Cleanliness and Disinfection. Facilities and methods for cleaning and the cleanliness of every part of the building and the equipment and utensils therein. Note the cleanliness of containers, chutes, grinding, cutting, and other machines and the nature and efficacy of arrangements for sterilizing tables, equipment, floors, hides, etc., with steam, boiling water, or other agencies.

9. Contamination by Rejected Carcasses or Parts. Adequacy and nature of facilities for avoiding contamination of edible products by rejected carcasses or parts during any part of slaughter, handling, or storage; the separation of compartments used for slaughter, handling, or storing edible products from living rooms or those used for inedible products or rejected parts. Containers for edible and inedible organs should be marked for purposes of identification. Uninspected or rejected meats or products should not be mixed or worked in the same machines with passed meats nor otherwise handled or stored in the same rooms where contact is possible.

10. Disposal of By-Products; Tanks. Adequacy and suitability of facilities for the disposal of all waste matters; the system of denaturing or otherwise disposing of rejected carcasses and parts, of handling rejected products which have been returned, and the methods of operation of tanks and disposition of tankage, and of incinerators.

11. Dressing Rooms, Toilets, etc. Adequacy and suitability of dressing rooms, toilet rooms, urinals, and lavatories; their location in relation to rooms used for edible products; adequacy and convenience of supply of hot and cold water, soap, and towels.

12. Employes. Number, suitability of dress, habits, cleanliness of hands and person, and appearance as to health of employes.

13. Vermin. Freedom from rats, mice, flies, and other vermin and methods used to exclude same. Exclusion of domestic animals.

14. Refrigeration. System and efficiency of refrigeration used in refrigerators, coolers, cold storage rooms, refrigerating cars, and refrigerator rooms on ships. Particular attention should be given the construction and repair, insulation and drainage, air circulation in connection with ventilation, degree of moisture, temperature and the location and accuracy of the thermometer, and cleanliness.

15. Handling, Packing, and Transporting. System of handling, packing, crating, storing, and transporting products, including suita-

bility, cleanliness, equipment, and repair of cars, ships, trucks, wagons, and other vehicles.

16. Storage and Issue Rooms. Number, suitability, condition as to temperature and dryness, ventilation, adequacy and equipment of all rooms or buildings used for storage purposes, including facilities at place of issue for inspecting, trimming, or otherwise conserving supplies and handling supplies retained for survey.

17. Other Sanitary Inspection Agencies. Is the sanitation of the establishment supervised by a representative of the Department of Agriculture or other official agency? Nature and sufficiency of the regulations under which this inspection is maintained.

CHAPTER IV

Ante-mortem Inspection of Food Animals

A. TRANSPORTATION OF FOOD ANIMALS

1. Food Animals Defined. Food animals as discussed herein refer to domestic cattle, calves, sheep, goats and swine.

2. Marketing Agencies. The producer may dispose of livestock direct to the feeder, or local packer or to a buyer. Several may combine to make up a group shipment. Farmers may organize coöperative livestock shipping associations. Also there is a national federation of livestock shipping associations. Food animals may be consigned to commission firms or to coöperative commission firms. The latter may establish relations with railroads, packers and the sanitary laws and their practices.

3. Regulatory Phases. The Army veterinarian should become familiar with the functions pertaining to the interstate commerce commission, the 28-hour law, regulations governing the interstate movement of livestock, regulations for the inspection and quarantine of food animals imported into the United States, the state sanitary requirements governing the admission of livestock, and any others in effect.

Twenty-eight Hour Law

AN ACT to prevent cruelty to animals while in transit by railroad or other means of transportation from one State or Territory or the District of Columbia into or through another State or Territory or the District of Columbia, and repealing sections forty-three hundred and eighty-six, forty-three hundred and eighty-seven, forty-three hundred and eighty-eight, forty-three hundred and eighty-nine, and forty-three hundred and ninety of the United States Revised Statutes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That no railroad, express company, car company, common carrier other than by water, or the receiver, trustee, or lessee of any of them, whose road forms any part of a line of road over which cattle, sheep, swine, or other animals shall be conveyed from one State or Territory or the District of Columbia into or through another State or Territory or the District of Columbia, or the owners or masters of steam, sailing, or other vessels carrying or transporting cattle, sheep, swine, or other animals from one State or Territory or the District of Columbia into or through another State or Territory or the

(*Permission United States Bureau of Agricultural Economics*)

FIG. 4. GOOD STEER CARCASS

District of Columbia, shall confine the same in cars, boats, or vessels of any description for a period longer than twenty-eight consecutive hours without unloading the same, in a humane manner, into properly equipped pens for rest, water, and feeding, for a period of at least five consecutive hours, unless prevented by storm or by other accidental or unavoidable causes which can not be anticipated or avoided by the exercise of due diligence and foresight: *Provided*, That upon the written request of the owner or person in custody of that particular shipment, which written request shall be separate and apart from any printed bill of lading, or other railroad form, the time of confinement may be extended to thirty-six hours. In estimating such confinement, the time consumed in loading and unloading shall not be considered, but the time during which the animals have been confined without such rest or food or water on connecting roads shall be included, it being the intent of this act to prohibit their continuous confinement beyond the period of twenty-eight hours, except upon the contingencies hereinbefore stated: *Provided*, That it shall not be required that sheep be unloaded in the nighttime, but where the time expires in the nighttime in case of sheep the same may continue in transit to a suitable place for unloading, subject to the aforesaid limitation of thirty-six hours.

Sec. 2. That animals so unloaded shall be properly fed and watered during such rest either by the owner or person having the custody thereof, or in case of his default in so doing then by the railroad, express company, car company, common carrier other than by water, or the receiver, trustee, or lessee of any of them, or by the owners or masters of boats or vessels transporting the same, at the reasonable expense of the owner or person in custody thereof, and such railroad, express company, car company, common carrier other than by water, receiver, trustee, or lessee or any of them, owners or masters, shall in such case have a lien upon such animals for food, care, and custody furnished, collectible at their destination in the same manner as the transportation charges are collected, and shall not be liable for any detention of such animals, when such detention is of reasonable duration, to enable compliance with section one of this act; but nothing in this section shall be construed to prevent the owner or shipper of animals from furnishing food therefor if he so desires.

Sec. 3. That any railroad, express company, car company, common carrier other than by water, or the receiver, trustee, or lessee of any of them, or the master or owner of any steam, sailing, or other vessel who knowingly and willfully fails to comply with the provisions of the two preceding sections shall for every such failure be liable for and forfeit and pay a penalty of not less than one hundred nor more than five hundred dollars: *Provided*, That when animals are carried in cars, boats, or other vessels in which they can and do have proper food, water, space, and opportunity to rest the provisions in regard to their being unloaded shall not apply.

Sec. 4. That the penalty created by the preceding section shall be recovered by civil action in the name of the United States in the circuit or district court holden within the district where the violation may have been committed or the person or corporation resides or carries on business; and it shall be the duty of United States attorneys to prosecute all violations of this act reported by the Secretary of Agriculture, or which come to their notice or knowledge by other means.

Sec. 5. That sections forty-three hundred and eighty-six, forty-three hundred and eighty-seven, forty-three hundred and eighty-eight, forty-three hundred and eighty-nine, and forty-three hundred and ninety of the Revised Statutes of the United States be, and the same are hereby, repealed.

Approved, June 29, 1906.

Feeding, Watering, and Resting of Live Stock in Course of Interstate Transportation

(*United States Department of Agriculture*)

In connection with the enforcement of the 28-hour law (34 Stat. 607), the Bureau of Animal Industry has made investigation of the feeding, watering, and resting of cattle, sheep, swine, and other animals while in the course of interstate transportation. The results of this investigation and the conclusions based thereon are announced as an indication of the views of the Department of Agriculture as to the minimum requirements of the law.

Feeding

The amount of feed which should be given to different classes of animals varies with the length of time between feedings and the weights of the animals. For each 24 hours the ration for horses and cattle should not be less than $1\frac{1}{4}$ pounds of hay to each hundred weight of animal; for sheep, not less than $1\frac{1}{2}$ pounds of hay to each hundredweight of animal; and for hogs, not less than 1 pound of shelled corn, or its equivalent in ear corn or other grain, to each hundredweight of animal. For periods greater or less than 24 hours, the rations should be greater or less, respectively, in the same proportion.

Unloading

The only practicable methods for railroads to transport animals other than hogs, without unloading during each period prescribed by the statute for rest, water, and feeding, are in "palace" or in similar stock cars and with emigrant outfits. There are cases in which exceptional facilities complying with the law make unloading unnecessary; for instance, specially equipped cars conveying show animals and blooded stock. In such cases care should be taken to observe the law. In all cases, if animals are not unloaded, sufficient space to permit all the animals to lie down in the cars at the same time must be provided.

Hogs may be fed, watered, and rested, without unloading, provided (a) the cars are loaded so as to allow all the animals to have sufficient space to lie down at the same time, (b) the trains are stopped for sufficient time to allow the watering troughs to be prepared and to allow every hog time to drink his fill, and (c) care is exercised to distribute properly through each car deck sufficient shelled corn, or its equivalent in ear corn or other grain, for each hog.

Unloading Pens

All pens into which animals are unloaded must contain adequate facilities for feeding and watering and suitable space on which the animals can lie down

comfortably for resting. Covered pens should be provided for unloading animals in severe weather.

Dead animals are unloaded after the live ones, and should receive the ante-mortem inspector's first consideration.

Dead Animals not to be Shipped with Live Ones

(*United States Department of Agriculture*)

It is reported that many shippers of live stock make a practice of loading dead hogs with live animals for shipment to market. Notice is hereby given that the current regulations of this department governing the interstate movement of live stock make no provision for the loading of dead animals with live ones for shipment, and this practice should not be tolerated. Such dead animals should be disposed of in accordance with the requirements of the local authorities.

4. Methods of Transportation. Live stock may be transported on land by rail in stock cars or in box cars, by auto trucks or wagons, or may be driven "on the hoof." Transportation by means of water may be conducted on boats, rafts or by swimming.

Animals may be carried in specially constructed stock cars having facilities for watering and feeding. Cattle, calves and sometimes sheep or hogs may be shipped in single-decked cars; however, sheep, hogs, and goats are usually shipped in double-decked stock cars. Sometimes box cars are used, but are not as well suited as to light, ventilation, and drainage as stock cars. Stock cars used for live stock should be clean and free from contagion.

Standard guage stock cars are practically standard as to width, but vary as to length. The inside width of single-decked stock cars is nine feet eleven and one-eighth inches to ten feet three inches and for double decked cars, nine feet eleven and one-eighth inches. Lengths inside run from thirty-four to forty feet. The standard length according to tariffs is thirty-six feet six inches. Cattle will load from twenty-two to fifty head per car, depending on age, size and weight. Sheep going to feed lots will load from one hundred fifteen to one hundred fifty head to the deck. Fat sheep will load from one hundred to one hundred twenty-five to the deck. Hogs will vary from fifty to seventy-five head per deck according to age, size, and weight. Calves will load fifty to seventy-five head per car according to size and weight. One author states that for hogs, four and one-third; sheep, two and three-fourths; and calves, three and one-third square feet of floor space is required for each animal. Cattle each require about twenty-two and one-half to twenty-six inches of the car length, cattle being placed crosswise in the car.

When livestock is ready for shipment, arrangements are made by the shipper with the local railroad agent for an adequate number of stock cars to be at the loading platform at a designated time. The shipper should have the live stock in the stockyards several hours in advance of the time for loading in order to allow them a rest period. The railroad should deliver clean sanitary cars in good state of repair, and if necessary, disinfected. The shipper furnishes the bedding for the cars as sand, cinders, earth, hay, straw, etc.

In loading cars, mixed lots should be partitioned off to prevent injury to the smaller animals from the large ones. Live stock should be distributed through each car and not allowed to pile up. Waybills containing the names of the consignor and consignee, the kind of animals, their number and car numbers are placed in charge of the train conductor. At destination these are turned over to a representative of the stockyards company.

5. Conditions in Transit Affecting Livestock. Livestock is a perishable product subject to shrinkage, disease, bruises and other injuries and destruction, enroute. Live stock shipping losses have been enormous. This has led to conferences and investigations by breeders, producers, shippers, farm organizations, stockyards, livestock and traders' exchanges, packers, and Governmental bureaus in an effort to reduce such losses. Certain transportation companies have formed a bureau employing veterinarians to operate on some of the larger markets in an endeavor to keep an accurate record and report of crippled and dead animals received, condition of stock cars on all in- and outbound shipments, perform necropsies when necessary and to supervise the proper rendering of dead animals. This service is maintained to fix the blame for casualties enroute.

Shrinkage of livestock in transit is dependent upon many factors as condition of animals at loading, fatness, temperament, season, temperatures, storms, train handling, time in transit, fatigue, excitement, nature and amount of feed and water enroute, etc. It is stated that under general conditions hogs shrink 2 per cent and cattle 4 per cent in transit.

Recommendations of the National Live Stock Exchange

(Report of Committees—1920)

Loading Stations, Pens and Chutes

We recommend that all carriers be requested to immediately make detailed investigation of all stockyards, reporting needed improvements and enlargement to their operating officers in charge of this department.

That adequate yards properly shedded be furnished at each loading station to accommodate its normal business. That where the volume of business equals 50 to 100 cars per year, at least two pens be properly paved. That where the volume of business justifies, all yards should be paved.

That an adequate supply of water and watering facilities be maintained where possible. That facilities for the drenching of hogs in warm weather be maintained where possible. That proper drainage facilities be installed in all yards.

That loading chutes be constructed where possible on a level with car floors. That edges of loading platforms be not to exceed six feet from center of tracks at car floor level.

That at all stations handling 100 or more cars per year, two chutes be installed where possible. That at all stock yards a movable double-deck chute be a portion of the equipment where permanent double-deck chutes are not installed.

That all yards should be kept in a clean and sanitary condition.

That proper receiving pens with unloading chutes for the purpose of unloading stock from wagons or trucks be installed at all yards.

Equipment

It is the sense of this committee that primarily the duty of furnishing suitable cars rests with the carriers. However, it is suggested that the shipper and carrier should co-operate in every practical way in the safe loading and shipment of live stock. And it is further suggested that the various organizations of shippers, exchanges and carriers shall make specific recommendations to their members as to how co-operation shall be effected.

Bedding of Cars

It is the sense of the Committee that sand is the most suitable bedding, and we recommend it as the standard bedding, when obtainable. When sand is not obtainable, shippers should be allowed to select such bedding as they desire. This Committee condemns the use of cinders, rock dust, coal slack or similar materials for bedding. Cars furnished for hog loading should not be bedded unless requested by shippers.

Loading of Cars

That the railroads be requested to placard each stock yard, station house, etc., admonishing care and careful handling in the loading and unloading of live stock. That the use of prod poles with prods in the ends thereof be abolished. That pitchforks and other inhuman instruments be done away with. That slap-jacks for the handling of hogs or other humane devices for the handling of cattle or sheep be used. That electric lights be maintained at the railroad yards where power is available. That all public market exchanges be requested to prosecute all parties inhumanly handling live stock.

Safe Carload Minima

Your Commiteee on Subject No. 5, "The Safe Loading Minimum of Each Specie of Live Stock in a Standard 36-Foot Car," having in mind during our

deliberations the purpose of this meeting, viz: A Reduction in Shipping Losses on Live Stock, begs leave to submit the following as their recommendations:

Cattle, 22,000 pounds
Hogs, D.D. 22,000 pounds
Hogs, S.D. 16,000 pounds
Sheep, D.D. 18,000 pounds
Sheep, S.D. 12,000 pounds
Calves, D.D. 22,000 pounds
Calves, S.D. 14,000 pounds
Stock cattle, 20,000 pounds
Stock hogs, D.D. 20,000 pounds
Stock hogs, S.D. 14,000 pounds

It is the recommendation of your Committee that the enforcement of a minimum on any specie of live stock beyond which it is reasonably safe to load should be condemned.

We wish to protest against the claim by carriers of overloading when live stock arrives at destination at minimum weight or under in damaged condition.

It is the sense of this conference that these carload minima represent the safe loading weight and are not an expression as to what the tariff minima should be.

Partitioning Mixed Cars

Your Committee believes further investigation and conference on this matter necessary and therefore recommends that while favoring the gate type of partition they believe a joint committee of the Freight Claim Association, The National Live Stock Exchange and Co-operative Live Stock Shippers should be called to devise a standard type of partition and method for using it.

28-Hour Law

It is recommended that the so-called twenty-eight hour law be amended, such amendment to provide that live stock consisting of cattle, calves, hogs, sheep, lambs, goats and kids could be confined not to exceed 36 hours, except that this limit might be exceeded in emergency cases under rules prescribed by the United States Department of Agriculture.

Feeding En Route

Shipper's instructions as to feed and water enroute should be strictly complied with; where no instructions are placed by shippers the live stock to be fed in compliance with the tariff rules and regulations and that a good quality of feed be furnished.

That the carriers should place instructions at all in transit feeding stations; that live stock must be handled with extreme care in loading and unloading; that they place the enforcement of these instructions under the jurisdiction of competent inspectors; also to give instructions to those inspectors that will insure the proper supervision and enforcement of the general instructions; also to place information in the hands of all who handle live stock, the unnecessary waste in animal products chargeable to bruises and other injuries which are the direct result of improper and careless handling, prod poles and other instruments that inflict bodily injuries be absolutely barred from use.

Drenching or Sprinkling En Route

That carriers should supply proper drenching or sprinkling facilities at terminal and division points and furthermore, to furnish all water stations with sufficient supply of hose so that if it becomes necessary to drench or sprinkle hogs in emergency cases that the facilities are available.

That the carriers place these facilities under the supervision of competent inspectors and to issue such instructions as will guarantee that hogs be given the proper attention as to drenching or sprinkling.

That instructions be explicit, clear and concise and the thought to be kept in mind at all times is that the carrier is responsible for the proper care of live stock while in its possession, and the importance of drenching and sprinkling live stock must have the careful attention of all employees handling this traffic.

Holding Stock in Cars in Terminals

That it is very important that the carriers see that all shipments of live stock are given preferred handling and prompt movement; that cars so loaded are not stopped in yards and terminals near buildings, or between cars, especially in warm weather.

Furthermore, that all employees of the carriers handling live stock be instructed by proper circular of instructions the great importance of handling in this manner and that competent supervisors be appointed whose duty it is to apply corrective measures to insure a strict compliance of said instructions.

Delay Between Terminal Yards and Unloading Chutes

That wherever practicable, all live stock trains into primary markets shall be scheduled directly into the chutes of the stock yards.

That The National Live Stock Exchange arrange with its members at all primary markets to keep a record of the date and hour of arrival of all live stock as follows:

1. In outer railroad yards.
2. At unloading chutes.
3. The hour of unloading at the chutes and report the facts at such time and in such manner as may be directed by the Secretary of The National Exchange.

Your Committee further suggests that each local exchange at the primary markets organize a Committee to include also railroad representatives.

1. For the purpose of arranging quick handling of live stock through terminals.
2. To collect data and keep a record of dead and injured live stock and to circulate the same to members of the live stock exchange, stock yard companies, packers and to the railroads.

Live Stock Train Schedules

That live stock schedules should be made with regard to reasonable speed, continuous movement, avoiding delays at terminals and arriving as early as possible during the night and early morning, so that all shipments may be on the morning market.

That wherever arrangements are in effect for running special trains with a given number of cars such arrangement shall be continued. Wherever no such arrangements are in effect the matter of special service is one to be determined between the shipper and individual railroads.

Unloading at Destination, Handling Within the Yards, and Loading Out the Marketed Stock

That stock yard companies employ in so far as possible only experienced men especially the ones in charge of the crews.

That stock yard companies should see that all equipment is in good condition.

Recommend that only flappers or electric poles be used in loading and unloading stock.

That every precaution should be used in unloading crippled animals that they be not further injured, and that the cripples be disposed of as promptly as possible after unloading. Sales to be made on basis of weight and price per pound.

Request that all exchanges institute a campaign of education on the subject of unnecessarily bruising live stock on the central markets.

Recommend that signs be placed in prominent places at all central markets calling attention to the employees that bruising animals means losses to some one, and that employees of stock yard companies, commission firms, traders, and packers, bruising animals will be fined or docked for the first offense and on the second offense will be discharged and not permitted in the yards. Those exchanges not having drastic rules covering the humane handling of live stock should pass such rules immediately. Every member should consider it his personal duty to see such rules enforced.

All exchanges should demand that clubs in the handling of live stock be abolished and insist that a whip or canvas flapper be substituted, except that in the sorting of hogs a pole may be used.

We recommend that all stockyard companies, commission men, and packers be asked to instruct their employees accordingly.

Recommend that the packers do not mix bulls, steers and cows for the purpose of driving to the packing houses.

Hog Loading and Transportation in Hot Weather

Hogs should be given light grain feeding before shipping.

Hogs should be brought to railroad loading station at least one hour before actual loading, to insure cool condition of hogs at time of loading.

Hogs should be loaded carefully so as not to excite or overheat them while being loaded.

Hogs should not be loaded more than one hour before actual departure of train.

Carrier should furnish clean car, or car should be properly bedded in accordance with shipper's instructions.

The Committee favors the use of sand as bedding.

Carriers should furnish watering facilities at loading stations for wetting bedding and car before loading.

Shipper should, wherever possible, thoroughly wet bedding, sides and top of car before loading.

Hogs should be thoroughly and carefully drenched in transit, preferably upon instructions of caretaker, and in absence of specific instructions carrier should exert utmost care to see that hogs are carefully drenched at every available watering station, being governed by prevailing temperatures.

Drenching service should be performed as soon after arrival of train at drenching stations as is possible, in order to avoid hogs becoming heated while side-tracked awaiting forwarding.

Summary of Hot Weather Hog Shipping Instructions

Suggestions for the railroads:

1. Furnish clean cars or cars bedded in accordance with shipper's suggestion.
2. Use sand in preference to other bedding.
3. Provide suitable facilities for watering the hogs and wetting down the bedding and interior of car.
4. Provide suitable drenching facilities for use en route.
5. Drench frequently immediately after the train stops but not after the car has stood until hogs are heated.
6. Keep loaded car where air currents circulate and not alongside buildings, engines or cuts of cars.
7. Provide extra hose at all tank stations for use in drenching in emergency cases.
8. Designate a competent inspector to exercise constant supervision over these facilities and their use.
9. Never throw water directly upon the hogs after they become heated. Run it upon the floor instead.
10. Report any careless or negligent shipper to the consignee and keep a complete record thereof.

Suggestions for the shippers:

1. Haul or drive your hogs into shipping station in ample time to allow them to become rested and cool before loading.
2. Insist upon a clean car bedded with sand.
3. Wet down the bedding and interior of the car before loading.
4. Give only a light grain feeding before shipping. Heavy feed means more body heat generated.
5. Load not more than one hour before the train is to depart.
6. Load slowly and carefully. Avoid excitement and do not beat or bruise the animals.
7. Load not to exceed 16,000 pounds in a standard 36-foot car during warm weather.
8. Have the cars drenched at every available point immediately after the train stops.
9. Use ice bags suspended from the car roof whenever possible. Six bags to a car will suffice.
10. Report any inattention or neglect to your commission man immediately upon arrival.

B. RECEIPT OF FOOD ANIMALS AT DESTINATION

1. Packers and Stock Yards Act. This act, approved August 15, 1921 is designed to regulate interstate and foreign commerce in livestock, livestock products, dairy products, poultry products and eggs; and,

for other purposes. It states that it is unlawful for any packer to engage in or use any unfair, unjustly discriminatory or deceptive practice or device in commerce, any unreasonable preference or advantage, apportioning the supply of any article in commerce, manipulating or controlling prices, creating a monopoly, restraining commerce; or to conspire, combine, agree or arrange to do, aid or abet any unlawful practice, etc. It defines stockyard's services as facilities furnished at a stockyard in connection with the receiving, buying or selling on a commission basis or otherwise, marketing, feeding, watering, holding, delivery, shipment, weighing or handling in commerce, livestock.

No person can carry on a business of a market agency or dealer at a stockyard unless registered, with the Secretary of Agriculture under such rules and regulations as he may prescribe. He must give his name, address, character of business and the kind of stockyards services furnished. He must furnish without discrimination reasonable services. Rates and charges must be just, reasonable and non-discriminatory. He must file with the Secretary of Agriculture and print and keep open to the public inspection at the stockyards, schedules of rates and charges for services furnished. The Secretary of Agriculture prescribes the form and manner of preparation, arrangement and the posting of schedules.

It states that it is unlawful for any stockyards' owner, market agency or dealer to engage in or use any unfair, unjustly discriminatory or deceptive practices or devices in connection with stockyards services.

It also considers complaints, hearings, penalties, and coöperation with livestock commissioners, boards of agriculture or other state or Government agency.

2. Handling. This includes the unloading of livestock from cars, handling and distribution in yards, classification, grading, tagging, weighing and dockage; sanitation, cleaning and disinfection of stock cars, docks, chutes, yards, runways and corrals; water supply, forage and bedding; also tuberculin testing, immunization of swine against hog cholera, dipping, spraying, and other veterinary services (see chapter V).

a. Unloading. At unloading a representative of the consignee may be present. Stockyards employes break the seals, unload the cars, note the kind of animals and count the number unloaded.

b. Fill. The animals are driven to clean pens, equipped with suitable watering troughs and feeding racks. Here they are allowed to eat and drink until satisfied. This is called the "Fill." Usually the

shipper stipulates the amount of feed he desires to be fed. The stock-yards company at a fixed price furnishes corn for hogs and hay for cattle and sheep. In arriving at the weight upon which freight charges are based a carload of hogs usually is allowed a fill of 300 pounds and a carload of cattle 800 pounds. This weight is determined subsequent to fill. It is stated that sheep do not make any gain after unloading.

c. *Market Classes and Grades of Live Stock.* (1) Cattle. (a) Killing Grades. These include beef steers, butcher cattle, and cutters and canners. Beef steers are divided into heavy-, medium- and light-weight grades each of which include prime, choice, good, medium and common sub-grades. Heavy weight beef steers weigh 1300 or more pounds, medium weight 1100 to 1300 pounds, and light weight 1100 pounds or less.

Butcher cattle include prime, choice, good, medium and common cows and heifers; choice, good and medium beef bulls and stags, and choice, good, medium and common bologna bulls and stags.

Cutter cattle include steers, cows and heifers; while canner cattle include steers, cows and bulls.

(b) Stockers and Feeders. These include feeders, stockers, milkers and springers. Feeder cattle are divided into heavy, medium and light weight steers; cows; and bulls. Heavy weight feeder steers weighing 1000 or more pounds, and light weight and medium weight feeder steers weighing 750 to 1000 pounds, are divided into selected, choice, good, medium and common sub-grades; while feeder cows and bulls are graded as choice, good, medium and common. Stock cattle include choice, good, medium and common steers, cows, heifers and bulls.

(2) Calves. (a) Killing Grades. These include choice, good, medium and common heavy, medium, handy- and light-weight calves also canner calves. Heavies weigh 250 or more pounds, medium weight calves 180 to 250 pounds, handy weight 120 to 180 pounds and light weight calves 90 to 120 pounds.

(b) Stockers. Stock calves are divided into selected, choice, good, medium and common sub-grades.

(3) Sheep and Lambs. (a) Killing Grades. These include lambs, yearling wethers, wethers, ewes and rams.

Lambs. After June 14, all sheep born in the Spring of the previous year are called "yearlings," and those in the current year are called "lambs." Lambs are divided into prime, choice, good, medium and common, spring, handy weight, medium weight and heavy weight

grades; or classed as culls. Handy weight lambs weight up to 84 pounds, medium weight 84 to 92 pounds and heavy weight 93 or more pounds.

Yearling Wethers. These are divided into prime, choice, good, medium and common, handy weight, medium weight and heavy weight yearling wethers; or classed as culls. Handy weight yearling wethers weigh up to 90 pounds, medium weight 90 to 100 pounds and heavy weight 100 or more pounds.

Wethers and Ewes. These include the prime, choice, good, medium, common and cull grades.

Rams. Rams are divided into good, medium and common grades.

(b) Feeder Sheep and Lambs. Feeder lambs, yearlings, wethers and ewes are graded as choice, good, medium and common.

(c) Breeding ewes. These are divided into choice, good or medium yearlings; or into choice, good, medium and commom old ewes.

(4) Goats. Goats are divided into choice, good and medium killers, or brushers, and kids.

(5) Swine. (a) Killing Grades. These include light-light, light-weight, medium weight and heavy weight, butcher, bacon and shipper hogs; packing sows; boars; stags; and pigs.

Light-light hogs weighing 130 to 150 pounds, light-weight hogs of 150 to 200 pounds and medium weight hogs of 200 to 250 are graded as choice, good, medium or common; while heavy weight hogs of 250 or more pounds are graded as choice, good and medium. Smooth packing sows weigh 250 or more pounds, while rough packing sows weigh 200 or more pounds. Pigs which weigh up to 130 pounds are graded as choice, good and medium.

(b) Stock or Feeder Pigs. These are divided into choice, good, medium and common light weight (80 to 100 pounds) and heavy weight (100–130 pounds) grades.

d. Other Handling. After selling, the livestock is weighed. Usually boars and stags are docked about 70 pounds and piggy sows 40 pounds. Discrimination or dockage also may also be given "lumpies," (actinomycosis of the head region), parturient cows or ewes, excessive fill, boars, rams, bulls, stags and injured animals, according to the market or buyer. The livestock then may be driven to the packer's or other pens.

Quarantine, isolation, dipping, tuberculin or other testing, vaccination, disinfection of premises and carriers or other live stock sanitary control measures may take place.

C. VETERINARY ANTE-MORTEM INSPECTIONS

Veterinary ante-mortem inspection consists of the examination of animals intended for food purposes before their slaughter and examination of the sanitary conditions under which such animals are handled. It pertains chiefly to inspection prior to purchase. In case of live animals bought on the hoof for slaughter, it becomes practically the inspection at receipt with such later examinations (corresponding to inspection in storage) as may be required. From the standpoint of abattoir inspection it includes the inspection of animals which have died in cars or pens, also yard inspection.

1. Sanitary Veterinary Ante-mortem Inspection. a. Purpose. The principal purpose of the ante-mortem inspection is to aid in detecting communicable diseases, thereby facilitating isolation and the proper disposal of diseased animals and preventing the transmission of such diseases to man or to other animals. The source of diseases may be traced and preventive measures inaugurated through coöperation with various sanitary agencies. It also affords a means of detection of "cold slaughtered" animals. Many infectious and toxic conditions fail to present visible alterations in the organs or tissues on post-mortem examination, while a ready diagnosis of such may be made ante-mortem. This inspection is a valuable safeguard to the consumers of meat.

Ante-mortem inspection is furthermore an aid to the conservation of the meat supply, not only in regard to animals in the stages of advanced pregnancy, but also in bringing prompt attention to animals which have recently given birth to young, to immature and exhausted animals, and to others, thereby, during the time such conditions exist, preventing their slaughter and subsequent post-mortem rejection.

b. When Required. All animals intended for food purposes should be given an ante-mortem inspection prior to slaughter whenever the services of a veterinary officer are available.

c. Inspection Equipment. The veterinary ante-mortem inspector should provide himself with a notebook, fountain pen, a standard clinical thermometer, and a suitable hand lens for demonstrating parasites (See Fig.1.)

d. When and Where Conducted. Antemortem inspections may be conducted on the reservation at time of delivery, on the premises of the owner or of the slaughtering establishment, at the unloading chutes and pens adjacent or later in yards, pens, alleyways, or at the scales. The final ante-mortem inspection should be made within 24 hours of slaughter.

e. Inspection Procedure. (1) On Receipt of Animals. The ante-mortem inspector should investigate the sanitary condition of all stock cars, unloading chutes, pens, alleyways, and runways. He should see that the same comply with all sanitary requirements. (see chapter III.)

A preliminary visual survey should be made of the interior of each stock car immediately after being unloaded and of the animals at the time of unloading, to note any manifest evidence of communicable disease, advanced pregnancy, recent parturition, immaturity, lameness, cripples, emaciation, and parasitism. Fallen animals unable to rise should be carefully observed.

The veterinary inspector should recommend that the slaughter of fatigued or exhausted animals be withheld until such time as they have recovered. If such animals are killed immediately upon receipt, incomplete bleeding may occur, with a reduction in the keeping quality of the meat. The meat also contains toxic substances as a result of fatigue which may be harmful. A rest period before slaughter should be allowed all such animals, varying according to the conditions of transit, temperature, and season, and the condition and fatigue of the animals. Whenever practicable this rest period should be of 12 hours' duration, and in no case of marked exhaustion should it be for less than 6 hours. This equally applies to animals delivered on the hoof which have been driven in from the range.

(2) Yard Inspection. The veterinary inspector should pass through all pens of animals at least once daily, making examination for sick, dying, or dead animals, or other defects. Recumbent animals should be aroused in order to note their physical condition.

The temperature should be taken and recorded of all animals unable to stand and of such others as may be desirable, especially in cases of suspected splenetic fever, hog cholera, anthrax, black leg, pneumonia, septicemia, or severe injury. A subnormal temperature may obtain just before death. A rise in temperature is the first indication of the onset of most communicable diseases. A carload, pen, or other lot of animals showing symptoms which suggest communicable disease should be segregated in a separate pen for further observation and the diseased animals isolated. The segregated animals should be examined daily and temperatures taken and recorded until the diagnosis is established.

f. Action. (1) Government Owned Food Animals. From a sanitary standpoint on ante-mortem inspection, food animals owned by the Government may be rejected outright, rejected pending further

observation or treatment, or passed for post-mortem as suspects. Those not included in one of these three classes may be passed for slaughter.

(a) Outright Rejection. Animals should be rejected outright if dead or dying or when there is evidence of rabies, tetanus, anthrax, blackleg, splenetic fever, advanced scabies, railroad sickness, or any other disease or condition which on post-mortem examination would require outright rejection. (See F. Action, chapter VI.)

Reactors to the tuberculin test should be rejected outright.

Close observation should be made in the yards, in the tank room or at the incinerator for evidence of disease or injury shown by dead or dying animals, in an effort to determine the cause and thus further aid ante-mortem and post-mortem inspections of the lots from which these animals came. Diseased animals sometimes are slaughtered hastily by the owner or operator in an effort to conserve their meat when there is likelihood of death from such disease. Because of the danger of meat poisonings in man from eating meat of animals so slaughtered, all such should be rejected outright and not taken into the slaughter room. This does not refer to recently injured animals, free from visible signs of disease, which are slaughtered without unnecessary delay.

(b) Tentative Rejection. Animals suspected of infection with communicable diseases or which have been in contact with such diseases should be held in isolation under constant observation. When the diagnosis is clear they should be rejected outright as above provided, or may be held for further treatment. Contacts may be passed at the termination of the period of incubation of the suspected disease. Coöperation with livestock sanitary officials is important and the requirements of all Federal and local regulations governing the handling of communicable diseases should be fully complied with.

Hogs suspected of being affected with hog cholera may be held apart for treatment with antihog-cholera serum if this procedure is not in conflict with local sanitary regulations. Upon complete recovery they may be released for slaughter. At the expiration of 30 days after serum treatment, if free from symptoms of cholera or other communicable diseases, they may be released for other purposes after proper disinfection has been carried out.

Immature animals may be held till mature, then released for slaughter or for other purposes if not exposed to communicable disease.

Animals in stages of advanced pregnancy and those recently giving birth to young may be released for breeding or dairy purposes if not exposed to communicable disease; otherwise may be held till fit for slaughter.

Vaccine animals with unhealed lesions showing pyrexia, if not exposed to a communicable disease, may be released for other purposes than slaughter.

Cows affected with milk fever may be held apart for treatment. Upon complete recovery they may be passed, provided other conditions are satisfactory.

(c) Suspects. All animals suspected for any other condition or disease not mentioned in paragraphs (a) and (b) should be held apart and slaughtered separately from the regular kill, as suspects subject to sanitary acceptance or rejection requirements on postmortem examination, or may be rejected outright.

(d) Passed for Slaughter. Food animals not included in one of the 3 classes discussed under paragraphs (a), (b) and (c), may be passed for slaughter and post-mortem inspection.

(2) Civilian Owned Food Animals. Any civilian owned animal, found on veterinary ante-mortem inspection to be affected with any disease or condition that may render its meat in whole or in part unfit for human food, should be excluded from the lot of animals to be slaughtered for the use of troops. All animals which are sound and fit for food so far as can be determined by the antemortem examination may be passed for slaughter and post-mortem inspection.

g. Diseases and Conditions. Some of the more common or important conditions met with on veterinary ante-mortem examinations of food animals include the following:

Cattle. Animals dead from disease or injury. "Downers," cripples, spreaders, gored animals, prod pole injuries of rectum, subcutaneous emphysema, advanced pregnancy, recent parturition, emaciations, horns growing into face; actinomycosis, tuberculosis, ringworm, tumors, black-leg, splenetic fever, septicemia, scabies, reactors to tuberulin test, infective mammitis, poisonings, milk fever and railroad sickness.

Calves. Immaturity, emaciation, bruises, calf diphtheria, ringworm, vaccinia, phlebitis of umbilical veins, scours, black-leg and splenetic fever.

Sheep. Dead animals: smothered, diseased, injured. "Downers," fractures, dislocations, advanced pregnancy, recent parturition, emacia-

tions, caseous lymphadenitis, malignant edema, dermatomycosis, scabies, lip-and-leg ulcerations; pneumonias, especially in old ewes, and poisonings.

Goats. Pneumonias, emaciations, takosis, Malta fever and parasitisms.

Swine. Dead animals: smothered, injured, diseased. "Downers," cripples, temperature of 106°F. or above, emaciation, boars, recently castrated stags, advanced pregnancy, recent parturition, insanity, exhaustions, immaturity, polyarthritis, poisonings, mange, necrotic stomatitis, hog cholera and associated conditions, rabies, reactors to tuberculin test, abscesses, actinomycosis, herniae and tumors.

h. Injuries Received Between Inspection and Slaughter. After ante-mortem examination and before slaughter, the following conditions may occur and should be taken into consideration when the post-mortem examination is made. Animals may slip and "spread" in the yards. They may become injured or killed from jumping off overhead runways or by becoming loose on the killing floor and jumping through windows or down elevator shafts. Vicious use of prod poles or twisting the tails of cattle in forcing them into killing chutes may cause injuries. In the shackling pens, hogs or sheep may become bruised by blows from clubs, shackles, or from being kicked. Hogs hung up may slip from the shackles and become injured from the fall, or may fall upon hogs in the shackling pen beneath, causing in some instances fractured vertebrae of the latter. Hogs may slip from shackles and, if alive, may plunge into the scalding vat. Sheep, upon being hoisted after shackling, may thrash around and become mangled in the machinery.

2. Procurement Inspection of Food Animals. The sanitary examination of cattle, calves, sheep, goats, swine or other food animal prior to purchase for breeding purposes or for slaughter includes a careful veterinary physical examination to be supplemented when necessary or required by additional quarantine measures, tuberculin or other tests, or laboratory examinations. All such animals should be sound, healthy and free from disease. National and State live stock sanitary laws should be considered.

The veterinarian if called upon may give such examination for sex, age, type, conformation, quality and stage of gestation as desired by the purchasing officer (see Fig. 5).

Age of cattle and sheep may be determined by an examination of the teeth (See classes of carcass beef, and Army requirements for carcass mutton, chapter VIII).

Standard methods of scoring of various food animals should be consulted. (Also see market classes and grades, above.)

If called upon to select cattle of a recognized beef breed, each individual should have representative beef type and form. Each cattle should be fat and have a low set, broad, deep, smooth body with level lines and covered with a thick, even covering of firm flesh. The hair, hide and bone should be of good quality. The general character and style are important indices of the quality of the meat.

Beef cattle may be purchased as fat cattle ready for the butcher's block, feeders and stockers representing the unfinished product, or as breeding cattle, the class from which the others are produced. Fat cattle are judged according to what they are at the time presented. In judging feeders, animals should be selected as give promise of putting on the cheapest and biggest gains and which develop into the best beef form when fattened. Breeding cattle should have true beef form.

In fat cattle, finish and quality of flesh and indications of a high dressing percentage are of importance. A pliable, thin or medium hide; fine bone; and soft, silky, glossy hair indicate a large dressing percentage of meat of good quality.

In feeders there is not the width and covering of flesh of fat cattle. The other points are generally the same as for fat cattle. They should have a rugged, constitution and "middle" enough to indicate that large quantities of feed can be consumed and converted into beef. For good constitution there should be a large heart girth; short thick neck and thickness in general. A good head is essential. It should be short and wide between the eyes, with a large muzzle and mouth and a prominent eye. These indicate a steer of quick-fattening qualities. Body should be of good conformaton, essentially the same as in the finished animal. It should be short, wide, of good depth and generally smooth throughout. There should be no undue prominence in the shoulders or hips. The hind quarter should be wide and "let down." The hide should be pliable and thin. A coarse hide indicates coarse meat of inferior quality. The hair should be soft, silky and mossy, and not rough or harsh.

Score Card for Fat and Feeder Beef Cattle

(United States Department of Agriculture)

Class —·—

SCALE OF POINTS	STANDARD	STUDENT'S SCORE	CORRECTED SCORE
A. General Appearance—38 per cent:			
1. Weight according to age; estimated, ... pounds; actual, ... pounds...........	10	....	....
2. Form—broad, deep, low-set, smooth, compact, cylindrical; straight top and underline; stylish..............................	10	....	....
3. Quality—loose, pliable skin of medium thickness; dense, clean, medium-sized bone; fine, soft hair...........................	8	....	....
4. Condition—deep, even covering of firm, mellow flesh, free from patches, ties, lumps, and rolls; full cod and flank, indicating finish..................................	10	....	....
B. Head and Neck—6 per cent:			
5. Muzzle broad; mouth large; nostrils large and open................................	1	....	....
6. Eyes large, clear, placid....................	1	....	....
7. Face short, jaws strong.....................	1	....	....
8. Forehead broad, full; ears medium-sized, fine texture.................................	1	....	....
9. Neck short, thick, blending smoothly with shoulders; throat clean with light dewlap..	2	....	....
C. Fore Quarters—8 per cent:			
10. Shoulder vein, full.........................	2	....	....
11. Shoulders smoothly covered, compact, snug, neat.....................................	3	....	....
12. Brisket trim, neat; breast wide and full......	2	....	....
13. Legs wide apart, straight, short; arm full, shank fine................................	1	....	....
D. Body—30 per cent:			
14. Chest full, deep, wide; girth large; crops full..	4	....	....
15. Ribs long, arched, thickly and smoothly fleshed..................................	8	....	....
16. Back broad, straight, thickly and smoothly fleshed..................................	8	....	....
17. Loin thick, broad, evenly covered...........	8	....	....
18. Flank full, even with underline..............	2	....	....
E. Hind Quarters—18 per cent:			
19. Hips smooth, evenly covered.................	2	....	....
20. Rump long, wide, level; tail head, smooth; pin bones wide apart, not prominent.......	5	....	....
21. Thighs deep, full...........................	5	....	....
22. Twist deep, plump..........................	5	....	....
23. Legs wide apart, straight, short; shanks, fine, smooth.................................	1	....	....
	100	....	....

DISCUSSION OF THE SCORE CARD

In judging fat cattle the score card is divided into 5 parts, each carrying a certain per cent of the 100 points of a perfect individual. The 5 parts and the relative importance of each are as follows:

	per cent
A. General appearance	38
B. Head and neck	6
C. Fore quarters	8
D. Body	30
E. Hind quarters	18
	100

Each of the parts is subdivided into smaller divisions and given a relative value. A brief discussion is given for each of the larger subdivisions as well as the smaller ones.

A. General Appearance

The general appearance includes weight, form, and quality, and condition. In comparing the general appearance of different animals one must consider the relative merits of these points as a single unit. The general appearance is a fair index to the placing of the animal, but the other details must be taken into consideration before a final decision should be made as to the relative merits of different individuals.

1. Weight. The weight of an animal according to its age is considered important as an indication that the greatest possible growth and fattening have been taking place ever since birth. Early maturity is desired in beef cattle because it is highly important to have animals which begin to put on flesh early and at the same time show size, vigor, and quality.

2. Form. In judging fat steers the point of view taken must be largely that of the butcher, and therefore the favored fat animal is of the low-set, deep, broad, compact sort that will yield a large quantity of valuable meat. A steer that is high on the legs, cut up in the flank, and small in heart girth rarely makes a good feeder and it is usually the case that such individuals do not develop into the most desirable fat kind.

3. Quality. In a fat steer quality means fine, clean bone, soft, mellow hide, fine, silky hair, and general refinement of features, together with a covering of flesh which is smooth and firm over all parts of the body. An animal having quality should in general show the absence of coarse joints, prominent hips, rough shoulders, or loose coupling.

4. Condition. This refers to the degree of fatness or finish which is found in the animal. A good indication of the finish of an animal is the fullness of the cod and the thickness of the flank. The cod is considered to be the last place to take on fat and when it becomes full the animal is generally well finished. In a well-finished animal the fullness of the flank will cause the bottom line to be comparatively straight. A well-fattened, medium-weight animal yields the best returns in the feed lot and the most profit on the block.

B. Head and Neck

The head and neck are not of importance on account of the meat they contain, but because they serve as an indication of the development of the rest of the body. In the feeder or unfattened individual the appearance of the head and neck can be taken as an index of the feeding qualities of the animal. The head serves as a condensed reflection of the rest of the body. To most experienced cattle feeders a view of the head is sufficient to tell whether the animal is a good one.

The head should be broad and short, because those qualifications accompany a thick, low-set, blocky body, while a long, narrow face usually accompanies a narrow and upstanding body and other features which are undesirable in a beef animal. The muzzle should be broad and the mouth large, because they indicate a good appetite. The nostrils should be large and open, showing good lung capacity. The eyes should be clear, prominent, and have a docile appearance, indicative of a quiet temperment. The face should be short and the jaws strong and wide apart at the base. As viewed from the side the profile of the head should show a wide angle. The ears should be medium sized, of fine texture, and covered with fine, silky hair. If horns are present they should be small or medium sized and free from undue coarseness.

The neck should be short, thick, and blend smoothly with the shoulders. The top line of the neck and the back should form a straight line. The throat should be clean and the dewlap light. A long, narrow, ewe-shaped neck is undesirable because it is often associated with poor feeding qualities.

C. Fore Quarters

The fore quarters include the shoulder vein, shoulders, brisket, and legs. The fore quarters should be well proportioned so as to form a smooth connecting link between the neck and body. Coarseness in the fore quarters should be avoided, but a fullness of the various parts is desirable.

The shoulder vein should be full and the shoulders smooth, compact, and evenly covered with flesh so that the neck fits snugly into the body. This part should be free from coarseness and the shoulder blades should be practically hidden from view. The brisket should be medium sized and prominent enough to make the body appear rectangular as viewed from the side. Freedom from coarseness is desired in the brisket. The legs should be short, straight, set well apart, and show refinement, which acts as an indication of quality and a high dressing percentage in the carcass.

D. Body

The body of the animal contains the most valuable cuts of beef. Included under this heading are chest, ribs, back, loin, and flank. In general the body should be broad and deep with the underline and the top line parallel or nearly so. The body should be well rounded with well-sprung ribs but free from paunchiness.

The chest of a good individual should be wide, deep, and have a large girth. The crops must be full so that there is no depression behind the shoulder. Fullness in this region will give the animal a more level top line and cause the body to appear truly cylindrical as viewed from the front or back. Long, well-arched ribs thickly covered with smooth flesh are desirable. The back should be broad

and straight and carry a thick covering of flesh. The most valuable part of the carcass is the loin, which extends from the last rib backward to the hip joints. It should be broad and thick and contain considerable fat, evenly distributed throughout the lean meat. This is equally true of other parts of the body but is particularly so in the case of the loin. In a thin animal the flank is primarily a web or fold of skin which connects the lower part of the body to the thigh. In a fat animal the flank becomes thick and causes the bottom line to appear straight. There is also a fore flank behind the elbow of the front leg. Both of these flanks should be well let down and in the well-finished animal should be thick and level with the underline.

E. Hind Quarters

The hips, rump, thighs, twist, and legs make up the hind quarters. The hind quarters should be deep and as broad as the shoulders. The hips should be smooth and show no prominence. The rump should be long and wide and gradually round off smoothly from hips to tail head. The rump should be free from patches and rolls caused by uneven deposits of fat. The thighs should be deep and full and the twist deep and plump. The twist constitutes the portion below the tail head on the inside of the leg. The thigh is the outer aspect of the leg. Both of these constitute the so-called quarter. The hind legs, as in the case of the front ones, should be wide apart, short, straight, and show a fine shank and fine-quality bone.

Great emphasis should be placed upon the development of the hind quarters because the cuts in this part of the body contain some of the highest priced and best quality meat. The hind quarters in the carcass contain about 23 per cent of the meat of the entire animal, but it must be remembered that the hind quarters on the carcass are proportionately smaller than the hind quarters on the live animal. If the carcass cut is made comparable to the part on the live animal it will be found that a large part of the loin will be classed with the hind quarters. In making out the score card for fat cattle the purpose has been to assign values to the various parts of the animal corresponding to the relative market value of the corresponding cuts and not to the corresponding relative weights. It is usually considered that the front half of the animal weighs 52 per cent and the hind half 48 per cent. In figuring the relative market values of these parts based on wholesale prices, the hind half of the carcass is worth about 54 per cent while the front half is worth about 46 per cent. This gives the reason why due emphasis should be placed upon the score of the hind quarters and the loin of the animal.

* * * * *

In scoring, each part is considered, and if judged as inferior to the perfect animal, "cuts" are made accordingly from the value given that part in the standard score. The sum of these estimated values gives the score of the animal judged. A "cut" of less than one-fourth of 1 per cent is never made, and a part of an animal seldom deserves a "cut" of more than 50 per cent of the value of that part.

CHAPTER V

Slaughter of Meat Food Animals

A. CATTLE SLAUGHTER

1. Sanitation. The holding pens, runways, chutes, knocking pens killing floors and other places which are used in connection with cattle slaughter, butchering, dressing, washing or other preparation, stamping and chilling should all comply with the sanitary requirements outlined in chapter III. The management of an establishment operating under United States Army Veterinary Inspection should thoroughly instruct all personnel to observe all the sanitary requirements pertaining to cleanliness of dress, person, implements and methods as required by regulations. Cattle should be reasonably clean at time of slaughter. Care should be taken not to excite the animals as this may result in incomplete bleeding and show in the flushed appearance and the rupture of surface blood vessels when the carcasses are placed into the cooler.

2. Fatigued Animals. The veterinary inspector should recommend that the slaughter of fatigued or exhausted animals be withheld until such time as they have recovered. If such animals are killed immediately upon receipt incomplete bleeding may occur, with a reduction in the keeping quality of the meat. The meat also contains toxic substances as a result of fatigue which may be harmful. A rest period before slaughter should be allowed all such animals, varying according to the conditions of transit, temperature, and season, and the condition and fatigue of the animals. Whenever practicable this rest period should be of twelve hours' duration, and in no case of marked exhaustion should it be for less than six hours. This equally applies to animals delivered on the hoof which have been driven in from the range.

3. Driving to Knocking Pen. An electric prod pole rather than a whip, club or spike prod pole will prove more efficient and will materially reduce bruises in driving cattle to the knocking pen.

4. Knocking. The knocking pens are long and narrow with movable floors and sides and usually are partitioned off with swinging doors to provide smaller compartments, capable of holding two to four cattle according to their size. Cattle which are to be stunned are

(*Permission United States Bureau of Agricultural Economics*)

FIG. 5. GOOD BEEF STEER

crowded into the compartments of these pens to limit their movement and to facilitate stunning. The "knocker" stations himself on an elevated plank runway just outside the pens. A four-pound double jack hammer is used to stun the animals. This hammer produces a concussion capable of rendering the animal unconscious. This stunning is used as a restraining measure to insure proper bleeding which is essential in the production of beef of good keeping qualities and appearance. A knocker should guage his blow so that in knocking thin skulled cattle an unsightly hemorrhage into the brain cavity will not result. Shooting may be resorted to in case of thick skulled bulls. Knocking should be conducted with the utmost humaneness. Due to an animal suddenly moving its head during the knocking operation, a horn may be knocked off or an eye badly injured.

When all the cattle in a compartment have been stunned, the side of the pen nearest the killing floor is pulled upward, the floor turning on a central axis tilts outward ejecting the animals out on the floor. In so ejecting there should be little violence, as vertebrae may be broken or dislocated.

5. Shackling. A short shackling chain is passed around both hind feet above the ankle joint and hooked tight. The animal is then hoisted to an overhead rail, when it is ready for the "sticker."

In shackling, if one leg is allowed to hang loose it prevents complete blood drainage, and the weight on one leg may cause a fractured leg bone.

6. Bleeding. The "sticker" makes an incision about eight inches long medially through the skin of the neck anterior to the sternum. A knife is then inserted upward to the confluence of the jugular veins which are then ripped open on one side of the neck using the heel of the knife. In the event the heart action has been suspended due to stunning, bleeding will result from gravity. Therefore, cattle should be bled as soon after stunning as possible, to prevent imperfect bleeding with its attending features of injected blood vessels and stained meat. In the event that the machinery stops and the stunned cattle can not be hoisted in a reasonable time, they should be stuck where they lie in order to insure their bleeding out. When the sticking operation is not properly performed, a certain amount of blood may be regurgitated into the lung cavity resulting in discoloration of the pleurae and to a certain extent a flushed condition of the entire carcass due to faulty bleeding.

Cattle should be bled for at least six minutes, and longer if possible (up to twenty-five minutes) before any further operation is attempted. As the keeping qualities of meat depend considerably on thorough bleeding, this should be as complete as possible.

Cattle intended for Kosher or Jewish killing are run into the knocking pens one at a time. One hind leg is shackled and the shackle attached to a hoist. The animal is ejected from the pen and hoisted simultaneously until the hind quarters of the animal are off the floor. The ventral part of the throat is tensed through the head being drawn backward by means of a large muzzle over the nose of the animal. The Jewish slaughterer (Schecter) employing a long, heavy, sharp knife rapidly cuts through the tissues of the throat just posterior to the lower jaw, using continuous strokes.

There is a question if koshered animals will bleed better than, or as well as, stunned animals. The blood from a koshered cattle is bright red and the heart action is not impaired during most of the bleeding; however, the retraction of the walls of the cleanly severed blood vessels frequently retards the escape of the blood. The blood from a stunned animal is dark and bleeding is largely due to gravity.

7. *Collection of Blood.* When blood is collected for food purposes the skin at the place of incision should be shaved, thoroughly washed, and dried. The knife used in the bleeding operation and hands and arms of the "sticker" should be thoroughly cleaned. The blood should be caught in a sterilized metal receptacle constructed to afford protection against dust or other contamination. The identity of this container should be preserved as pertaining to the carcass from which the blood was drawn. Defibrination should be accomplished with a sterile metal defibrinating fork, and in no instance should the fingers come into contact with the blood or the inside of the container. If any suppurative lesion, however slight, or other gross lesion of infection or parasitism is noted anywhere in the carcass on post-mortem inspection the blood should not be used for food purposes. The blood from animals slaughtered by cutting the throat is usually polluted with stomach ingesta and therefore should not be utilized for human food.

8. *Heading.* After bleeding has been completed, the head is skinned out. When skinning the front of the neck, care should be taken that the ball of the tongue is not removed with the hide exposing the lean tissues of the tongue.

To prevent contamination of beef heads during the process of skinning and removal from the carcass, they should be skinned and un-

jointed without severing the trachea and oesophagus. When ready to be removed, the head should be grasped by the lower jaw and lifted upwards to prevent contact with the paunch contents which may escape when the oesophagus is severed. Heads should not come into contact with the floor. The blood gutter and floor adjacent should be kept reasonably clean.

If long cut tongues are to be made, the trachea is cut four rings behind the tongue; if short cut, one ring behind.

When the head is removed, some means should be provided to make identification of the head possible until the post-mortem inspection has been completed. Numbered tags, racks or head chains may be employed for this purpose. The heads are then conveyed to a section of the killing floor set aside for head inspection.

9. Preparation of Head for Inspection. The head, after removal from the carcass, should be thoroughly washed, as a bloody condition renders examination difficult and more or less ineffective; it should then be prepared for inspection. The tongue should be sufficiently detached to allow a proper examination to be made of the internal muscles of mastication, and also to insure conditions favorable to an adequate tongue and tonsil inspection.

10. Pritching of Carcass. After the head has been removed, the carcass is lowered to the "bed" where the carcass is propped or pritched on its back, using a pritch pole. The pritch is a wooden rod about 30 inches long with a metal ferrule and spike at each end. Here the legs are removed and skinning commenced.

11. Foot Skinning. The dew claws are removed, the feet skinned out, then disarticulated at the knee and hock joints, the carpal and tarsal bones remaining on the carcass. When legs are intended for edible purposes their handling should insure cleanliness. In any event they should not be thrown on the floor, but into proper containers.

12. Ripping Open. The carcass is next opened down the ventral median line from the incision made at the time of bleeding to the pizzle butt. The Jewish examination of the carcass may be conducted at this time on koshered cattle. The schecter makes a slit in the diaphragm, inserts his hand into the thorax and explores the pleura for adhesions.

13. Tying the Oesophagus. A cut is made alongside the trachea avoiding injury to the sweetbread or thymus gland which is left entirely on the left side of the neck.

The oesophagus should be separated from the pluck and trachea in a sanitary manner. The oesophagus is separated from the trachea with a knife midway between the pluck and the neck end, to the extent of about three inches. A rod with a worm similar to a corkscrew is next used, being inserted into the incision between the oesophagus, and trachea, screwed around the oesophagus, pushed forward separating the oesophagus from the trachea and pluck to the mouth of the paunch. The rod is then drawn backward to within two rings of the end of the trachea. These two rings are then cut from the trachea, left attached to the oesophagus, and a knot is tied to the oesophagus, to prevent any paunch manure from being expelled. The oesophagus may then be pulled into the abdominal cavity.

14. Floorsman. The brisket, belly and cod are skinned. Open up leg incisions are made in the hide. "Siding" is next in order and consists in skinning the hide away from the sides. This operation requires considerable skill to prevent scoring the hide or cutting away any of the flesh.

15. Breast Bone Sawer. This operation should be conducted from the neck end backward. The caul fat may be removed at this time and should be held separate.

16. Aitch Bone Opening. The pizzle is removed to the pizzle butt, the scrotum cut off and the testes removed if a male. Udders of yearlings heifers are cut in two at the middle, while heavily lactating cow udders are removed. In order to prevent the unnecessary contamination of carcasses by pus or other objectionable material from the mammary glands, all such which have lactated should be removed from carcasses without opening the milk ducts or incising the glands, teats or any abscess present. Parts contaminated with pus should be trimmed off and rejected. The cartilage of the aitch bone is cut with a knife, a cleaver or a saw, at the center line.

17. Rumping. An incision is made in the gam cord, a spreading device on a hoist is connected, the carcass is pulled forward to the dressing bed and the hind quarters elevated so that the rump is about four feet from the floor. Rumping, bung dropping and tail ripping follow.

18. Hide Dropping. Fell pulling and beating, clearing out and hide dropping take place. The hide from carcasses rejected for tuberculosis or anthrax should be retained and treated as outlined in chapter VI. The hides from carcasses passed for food are inspected by the house for scores and cuts. The hides may be graded out on the killing floor or later in the hide cellar to which they are dropped.

19. Evisceration. The carcass may be eviscerated on the "bed" or in some modern abattoirs it is placed on a belt chain system and is carried progressively forward to the eviscerator, Army Veterinary Inspector, splitters, trimmers, washers, etc., on its way to the cooler. Provision should be made to prevent viscera or other parts of carcasses from coming into contact with the floor. All openings of organs, as the alimentary canal and bladder, should be ligated to prevent contamination of the carcass or viscera with their contents. In some abattoirs the viscera is removed entire. The female genitals with the fetus, if present, should be removed and rejected. The viscera is dropped into a metal viscera truck or on a moving table. It is then examined by the Army Veterinarian as outlined in chapter VI. Under no circumstances should the viscera be dropped on the floor. In detaching abscessed livers care should be taken to pervent pus contamination of the carcass and viscera. In the event of pus contamination of the carcass, a tentative cleansing with boiling water should be required immediately. This, however, is not sufficient in itself, and is to be supplemented with trimming and rejection of the parts affected. The latter procedure is usually accomplished after the cervical vertebra have been divided. If the sternebrae are contaminated, they should be trimmed off with a cleaver prior to hoisting. In case the viscera truck or table becomes contaminated from diseased or contaminated viscera, it should be rendered as clean as possible before again being used.

Boiling water should be used for this purpose. In the event of a carcass being set aside for further post-mortem examination, all parts including the head, viscera and hide should be retained until final disposition by the Army Veterinarian.

20. Splitting. Great care is exercised in splitting beef carcasses, excepting canner cows and bologna bulls which are not to be sold as block beef. The sacral bones may be split medially with a cleaver or saw, then the remainder of the vertebrae to the cervical segments are divided evenly with the cleaver. After the hide has been dropped from the fore quarters the cervical segments are divided with a cleaver (neck or chuck splitting) separating the carcass into two halves.

21. Rail Inspection. The carcass now passes a rail inspection by an Army Veterinarian as outlined in chapter VI, such trimming is done as is required and such other measures taken as are necessary.

22. Trimming. The thymus gland (neck sweetbread) is removed from young animals, trimmed and sent to the chill room. In older

cattle it remains on the carcass, being atrophied and composed mostly of white fibrous connective tissue.

All outside bruises are trimmed off. In case of cuts and scores on the outside of the carcass, the surrounding fat may be pulled over and skewered. The tail is removed and sent to the cooler. The spinal core is pulled, the diaphragm trimmed, the aorta and jugular removed and the heart fat trimmed.

All loose fragments of tissues on the neck and other regions are trimmed away to improve the appearance of the carcass. Clean cloths are skewered under the kidneys and along the neck to absorb any blood from the large blood vessels and thus prevent soiling of the meat.

23. Scribe Sawing. The spinous processes (fin bones) of the dorsal vertebrae of the third to thirteenth segments are sawed with a scribe saw, then pounded outward to an angle of about forty-five degrees. This gives a thicker effect to the rib and loin, adding considerable to appearance.

24. Washing. The carcass is thoroughly washed with water of about 120° F., by means of showers. This is supplemented by scrubbing and washing both the inner and outer surfaces with fountain scrub brushes to remove all blood and dirt. Care should be taken to thoroughly remove all fecal contamination of the pelvic or "crotch" fat. Wash water should be clean and of unquestioned source, and wash cloths and brushes should be kept sanitary. The carcass is then scraped and thoroughly dried with warm cloths. Carcasses should be as dry as practicable upon being sent to the cooler.

25. Branding. All carcasses passing the Army Veterinary Sanitary Inspection should be branded on each wholesale cut and on each kidney in accordance with regulations. (See chapter VII.)

26. Weighing. The carcasses are weighed before going to the chill room. The weight, also "hot-grade," are marked on a tag fastened to each carcass.

The dressing percentage will vary according to the breed, type, sex, quality, condition and fill of the animal. The average steer will dress out about 53 per cent. Poor canner cows may dress below 40 per cent, good to choice steers may dress 56 to 59 per cent, and prime or fancy steers from 59 to 63 per cent. It is stated that the world's record is that of a spayed heifer, 76.75 per cent.

For the disposition of the edible organs, trimmings and by-products of beef see chapter VIII.

27. Miscellaneous. a. Emergency Slaughter deserves special attention as it involves injured and sick animals whose life appears threatened, and as a conservation measure they are hastily slaughtered. Emergency slaughtered animals, (with the possible exception of a Government owned one with a recent simple leg fracture), as a rule, should not be considered for Army consumption as some cases of fatal meat poisoning have occurred following emergency slaughter.

b. Cold slaughter refers to the fraudulent manipulation of sticking, cutting and dressing the carcasses of dead unslaughtered animals. Inspectors should be on the lookout for these at all times. The absence of bloody infiltration of the edges of the wound, the injection of blood vessels and other manifestations should be considered.

c. Slaughter of Government-owned Animals may occur sometimes on a farm, on the military reservation or in a small packing house where Army inspection is maintained only for part of its output. In the last instance the inspector should require clean, sanitary compartments, equipment and implements and full sanitary measures throughout and, if possible, the Army animals should be slaughtered the first run of the day to avoid possible contamination from polluted floors, implements and butchers.

d. In the event it is found necessary to slaughter animals retained as suspects or held apart for some sanitary reason, they should be slaughtered at the end of the day's kill.

e. For conditions prohibitive of slaughter for the Army, including the lack of a proper ante-mortem inspection, see chapter IV.

B. CALF SLAUGHTER

1. Slaughter. Calves are usually slaughtered and dressed on the sheep killing floor using the same equipment, but may also be butchered on the cattle floor. They are stunned with a hammer or koshered, and are bled as in cattle slaughter.

2. Washing. When calf carcasses are dressed with the hide left on, the skins should be thoroughly washed with water and scrubbed with brushes to remove all manure, dirt, or other foreign material, before evisceration. The excess water should be removed from the hair by hand scrapers or drying cloths.

3. Hides. Carcasses and parts of bovine animals over 12 months old should not be considered veal or calves. In the slaughter of such animals the hides should be removed at time of slaughter to afford opportunity for proper inspection.

Calves heavily infested with lice (Hematopinus vituli or Trichodectes scalaris) should have their hides removed immediately after slaughter to prevent the parasites from crawling on the meat. When infested with splenetic fever ticks (Margarapus annulatus) carcasses should not be taken from establishments until the ticks or the hides are removed. In any event when the hide is not removed, the inspector is handicapped in examining for bruises and blackleg lesions. Hides should be removed from carcasses which show evidence of being bruised; also from calves originating in areas quarantined on account of Texas fever.

The hide is left on calf carcasses to conserve the moisture and to preserve the color. When veal is exposed to the air it dries out on the surface, becomes dark and unattractive.

4. Dressing. The skinning and removal of calf heads should be accorded the same treatment in respect to preventing contaminations as is outlined for the handling of beef heads. The feet are removed at the knee and hock joints as in cattle. The aitch bone and sternum are cut through and the viscera removed. The testes of a male animal should be removed and rejected. The carcass may be dressed "pluck in" to meet a limited demand. In this event thorough drainage of the pleural cavity should be provided and the thorax spread to afford good air circulation. During holidays a few selected fat carcasses may be specially caul dressed. The neck should be neatly trimmed. Carcasses with the hide left on are not split.

5. Post-mortem Inspection. Calves are subject to the usual post-mortem inspection on the killing floor. (See chapter VI.) Calves slaughtered on a farm, when presented for inspection at a station should have the organs, other than the stomachs, intestines and bladder held by their natural attachments. It is a good plan to advise the farmer supplying veal to strip out the liver, lungs and heart, still attached to the carcass by means of the trachea and oesophagus, place them into a clean pail to prevent contamination; and to spread the thorax to provide for ample air circulation within the carcass, and thus aid in preventing spoilage during its transportation prior to inspection.

6. Branding. Veal carcasses passed for food should be branded according to regulations (Also see chapter VII). After being weighed they are placed into a cooler.

7. Dressing Yields. This varies from 58 per cent for skim milk fed calves to 68 per cent or more for choice native calves dressed with hide on. The average yield is about 63 per cent.

For the disposition of edible organs, trimmings, and by-products of veal, see chapter VIII.

C. SHEEP SLAUGHTER

1. Slaughter. Sheep are secured for slaughter by shackling one hind leg. They are then hoisted to an overhead rail usually in pairs, hanging head downward. They are killed and bled by sticking the throat just posterior to the right jaw. This severs the large blood vessels of the neck. The collection and handling of blood for food or medicotherapeutic purposes should be done in a sanitary manner, and its identity maintained until the carcasses pass inspection.

2. Dressing. The style most commonly used in dressing sheep and the best grade of lambs is the plain or round-dressed (R.D.). In general, the pelt, head and toes are removed and the forelegs folded at the knee; they are opened from the cod or bag to the sternum, which is split to allow proper drainage and inspection. After thorough bleeding, the face and lower legs are skinned and feet removed. The carcasses may then be hung on the dressing rail or on the endless chain system which carries them progressively forward for butchering and dressing. The hind legs and neck are partially skinned. The neck is opened and oesophagus is tied and severed. The pelt is split the full length of the belly, and skinned back first with a knife, then with the fist. Rumping follows. At all times care is taken to prevent injury to the "fell," the subcutaneous white fibrous connective tissue subjacent to the pelt. In rumping, especially in muddy weather, care should be taken to prevent stains on the hind legs resulting from filthy hands. This stain is very hard to remove, even with bristle brushes and when pronounced, usually requires trimming.

The shanks remain on the carcass. The fore shanks are folded back at the knee and either skewered to the arm, or are restrained by means of a tendon raised through a slit in the back or the forearm. The hind shanks are tied together with a cord inserted beneath the tendons, and the carcass is suspended in the cooler from this tie.

The fore feet of lambs are removed by a fracture through the epiphyseal cartilage of the distal end of each large metacarpal bone, leaving a broad, moist, dentated, pink surface characteristic of the "break joint" of lamb. The age at which the ossification of this epiphyseal cartilage takes place depends upon sex, breed, feed, etc. The "break joint" of yearlings is harder, whiter and not as smooth as in a lamb. In mature sheep, the rounded, smooth, distal articular

end of the large metacarpal bone is evident, the break joint not being present. In the adult sheep artificial break joints are produced sometimes by means of using a large pair of pinchers, breaking off the articular end of the large metacarpal bone. The surface produced does not resemble the true break joint of lambs, it being white, hard and dry with bony spiculae showing.

It is important from a sanitary standpoint that carcasses be washed and dried thoroughly before butchering proper begins. The aitch bone of sheep is not cut as in the case of cattle and calves. The rectum is loosened and dropped into the pelvic cavity. Care should be exercised to prevent rupture of the urinary bladder or liberation of gastric contents. The oesophagus should be ligated to prevent the escape of stomach contents during the process of dressing and care should be exercised to prevent the bursting of the oesophagus when the paunch is being removed from the carcass.

The anus, neck of the bladder, stub of the penis and testes, or, the female genital organs, together with the fetus, if present, also the spleen should be removed and rejected. The identity of all viscera and parts should be preserved until the carcass has been finally disposed of.

The sternum should be split medially through the entire length, proper drainage of the thoracic cavity provided and clean spread sticks placed inside the fore-ribs. Sheep may be dressed pluck in or pluck out. The pluck consists of the heart, lungs, liver and trachea and is either left attached to the carcass or removed, as indicated by these terms. Sometimes lambs, particularly genuine spring lambs, are dressed with the pluck in, but this is seldom done with mature sheep. When dressed pluck in, the lungs, liver and heart should be sufficiently detached to permit of a ready examination.

Sometimes the head is removed with the pelt, but usually the pelt is entirely removed leaving the head attached to the carcass until the post-mortem inspections have been completed by the Army Veterinarian.

"Christmas dressed" carcasses, on which so-called "diamond dust" is used for ornamental purposes, should be considered as contaminated.

Caul dressing(C.D.) is practiced in certain localities, especially around the holidays and for spring lambs. The back is broken and the carcass is "spread" by means of two clean back sticks. The caul is then skewered over the carcass, while still warm, being draped over the hind legs and face. Two slits are made over the kidneys which are pulled through. These carcasses may be dressed pluck in. It is

essential that the caul used be from the same individual and that it is free from contamination and parasites. In the past, it was a practice to fradulently use in some instances the heavy fat caul from a sheep in good condition to cover over the carcass of a light thin animal. This fat was then sold at carcass prices as also were the back sticks. Such practices as these are no longer permitted.

The term "pelt on" refers to lambs from which the pelt and head have not been removed. This style is generally confined to light lambs. They are opened the same as round lambs, and in some markets are dressed with back-sets with the caul laid over the belly. In this style of dressing, the pelt should be thoroughly washed before the carcass is opened for evisceration, to prevent contamination of the meat from dirty wool.

3. Post-mortem Inspection. The details of this inspection are given in chapter VI. After post-mortem examination, all inedible and rejected portions should be removed. The carcass should then be thoroughly washed, using clean water and clean wash cloths. Stamping should be accomplished in accordance with the regulations. (Also see chapter VII.)

4. Cooling. The carcasses are then hung on racks, weighed, then run into the chill room.

5. Dressing Yields. These vary according to age, sex, breed, condition and fleece. The average for all classes is 50 to 54 per cent. Old, thin, ewes with a full fleece dress about 35 per cent and lambs as high as 55 per cent.

The disposition of edible organs, trimmings and by-products of mutton is given in chapter VIII.

D. SWINE SLAUGHTER

1. Handling Prior to Slaughter. In driving swine to the abattoir they should never be whipped or hit with a stick or club as a bruised spot results rendering that part of the meat so injured, either greatly reduced in quality, or wholly unfit for food. Driving is best done with a flat canvas strap persuader.

By hurrying hogs too rapidly, worrying or exciting them, especially in hot weather, over heating may result. The heat-eliminating powers of swine are very limited and fat animals may soon succumb to over exertion. Meat from hogs slaughtered in an overheated condition does not chill out properly and frequently will become sour.

After reaching the packing-house overheated hogs should be allowed to rest several hours before slaughter, usually in pens on the same level with the shackling pen. The floors of these holding pens should be kept clean, and good air circulation provided. Here the hogs should be kept as cool and quiet as possible. Any little bunching or crowding of the animals may cause them to smother.

Water should never be thrown directly upon hogs which are heated. Instead they may be cooled by drenching the floor with running water. Icebags may be suspended over the hogs in very hot weather.

2. Shackling. The shackling pens are crowded to capacity to facilitate the work of shackling. The hogs should be driven close to the shackle and the shackling chain placed around the hind leg nearest the hoist.

Hogs are shackled by one hind leg just above the hock, then elevated by means of a revolving wheel or conveyer to an overhead inclined rail. Heavy hogs on being jerked from the floor in the hoisting operation, frequently become injured in the hip joint region resulting in a dislocation and the rupture of blood vessels in that part, thus damaging the ham. In shackling pens, hogs should not be bruised by blows from clubs, shackles, or from being kicked. Hogs hung up sometimes slip from the shackles and become injured from the fall; or may fall upon hogs in the shackling pen beneath, causing in some instances, fractured vertebrae of the latter. In some houses hogs may slip from the shackles and, if alive, plunge into the scalding vat.

3. Sticking. As soon as the hog is hung on the inclined rail, which is well greased, it slides down to the sticker. The hog is stuck with a knife having a double edged, straight, six to eight inch blade. The knife is inserted medially anterior to the sternum, thrust toward the heart, and withdrawn with a cutting motion. The knife should go straight and make a clean cut about 3½ inches long enabling the blood to escape freely and rapidly. This blood is estimated as about 3 per cent of the animal weight.

Should the knife be deflected in the sticking operation, the result will be a "stuck" shoulder which, becoming infiltrated with blood, will cause injury and loss of such meat through subsequent trimming. A hog should hang on the bleeding rail for at least six minutes before being dropped into the scalding tank. This will provide for ample blood drainage.

4. Scalding. After the animal has bled thoroughly and life is extinct, it is slipped from the shackles and dropped into the scalding vat. This

vat is a long wooden tank filled with water heated by steam to about 146°–147°F. The temperature of this water should be controlled by a thermostat and should not go above 150°F., as cooked carcasses may result. A little soap or a weak alkali as sal soda, and, sometimes bile is added to the water to loosen the scurf and to cleanse carcasses thoroughly. The scalding solution should not be used when very dirty, but should be reasonably clean and renewed as often as is necessary.

Usually hogs will float in the scalding vat, but occasionally one will become a "sinker," remaining on the bottom. It frequently is "lost" for a period of time when the skin becomes cooked. The scalders, armed with long iron-piked poles should be on the look out for these submerged hogs. The hog carcasses should be moved progressively through the scalding vat by the scalders to the farther end of the vat. From three to four minutes is usually long enough to scald a hog depending on the season of the year, individuality of the animal and the hardness of the hair. When sufficiently scalded, as shown by the hair and scurf slipping easily when plucked, the carcass is ready for dehairing.

Should a hog not be scalded thoroughly, the hair and bristles will break off at the roots in the dehairing process, resulting in a dark-appearing second grade carcass. Hogs that are scalded too long show a cooked condition of the skin which may be badly torn in the dehairing machine.

5. Dehairing. After proper scalding a hook may be inserted beneath the tendons of the hind leg, or the leg shackled, then attached to a hoist which carries the carcass out of the scalding vat and through the dehairing machine where most of the hair and scurf is removed. Instead of the dehairing machine, the carcass may be scraped by hand, using bell scrapers or knives. The amount of bristles per hog carcass averages about $1\frac{1}{2}$ to 2 pounds. Bristles should not be allowed to accumulate and provision should be made for their proper disposal.

Next the carcass passes to a scraping table or on a chain where any remaining hair may be shaved off. Before going to the chain, clean gambrel sticks should be inserted in slits made in each of the hind legs from the hocks to the fetlock.

The dew claws and toes should be removed. Singeing of any hair and removal of remaining scurf should take place. The hair from the eyes and ears should be burned out and the nares of market hogs should be thoroughly cleaned with a jet of steam. All carcasses

should be thoroughly showered with water. All fallen carcasses should be hoisted promptly to the chain and cleaned thoroughly.

All hair, scurf and dirt should be removed from hog carcasses, and the carcasses thoroughly washed and cleaned before any incision is made for inspection or evisceration.

6. Butchering. In all but market hogs or suckling pigs the head is unjointed at the occipito atloid joint and almost severed from the body, exposing the principal cervical lymph nodes for the Army Veterinary Inspector. The carcass is then opened, the bung gut dropped and evisceration completed.

Genital and urinary organs are removed. Care should be taken to avoid urinary contamination from the bladder, and pizzle pouch in males. Fecal contamination should also be avoided. Genital organs and fetuses should not be thrown onto the floor which should be kept clean. When the initial belly incision shows an extensively diseased condition, the evisceration should be completed only in the final room, thus preventing contamination of the viscera bench. This would include scrotal abscesses, gross abdominal abscesses, tubercular lesions, etc.

The viscera consists of the digestive organs, accessory digestive organs, the spleen, the respiratory organs and the heart. The viscera as a whole is termed a "set." The trachea, thoracic viscera and liver together consitute the "pluck," or "haslets." The pelvic bones are called the "aitch" bones, the sternum the "breast" bone, the mesentery the "ruffle" and the lungs the "lights."

Lungs should be removed and rejected as they are always more or less contaminated with tank water. Kidneys should always be thrown to the inspection table where they are examined for hog cholera lesions. The "gut" bench should be kept clean, and jets of boiling and cold water should be available to sterilize the table, or to clean any contaminated viscera so that a proper inspection can be made. The identity of the viscera and carcass must be maintained until the veterinary inspection is complete.

7. Dressing. Next in order are ham facing, splitting, leaf lard pulling, fat scraping, trimming, neck scraping, washing, and the veterinary rail inspection. (Care should be taken in facing hams so as not to injure the thin fascia covering the face of the ham. If torn or cut it presents a rough, uneven appearance, the curing pickle and soaking water penetrate more rapidly, and there may be a tendency to sour and the ham dries out quickly during smoking.) Market hogs or ship-

per pigs are not split. Abscesses and bruises are trimmed out and "buttons," the calluses from fracture ribs, removed. Carcasses or parts passed for food should have all rejected and inedible parts removed. Food carcasses emerging from the final room should be thoroughly washed.

8. Branding. Stamping should be done in accordance with the regulations. (Also see chapter VII.)

9. Cooling. Before the carcasses enter the hang room or cooler, they are weighed. The hog carcasses may be allowed to hang two or more hours in an open room, the "hanging floor," without refrigeration, before passing into the chill room proper. This allows a considerable amount of animal heat to escape along with some moisture. Hog cooling is taken up in chapter VIII.

10. Dressing Yields. The dressing yield of a hog depends upon quality, condition, fill, breeding, age, sex and weight. Barrows dress out higher than sows of the same weight. With the head off and leaf lard out prime hogs will dress 78 to 80 per cent, and lighter, not well finished animals about 65 per cent. Shipper pigs will average 78 to 80 per cent.

For disposition of edible organs, trimmings and by-products see chapter VIII.

(*Permission United States Bureau of Agricultural Economics*)

FIG. 6. MEDIUM STEER CARCASS

CHAPTER VI

Post-mortem Inspection of Food Animals

A. GENERAL

1. Definition and Purpose. The term post-mortem inspection refers to an examination of carcasses of animals slaughtered for food purposes. Its purpose is to protect the health of the consumers of meat by eliminating carcasses or parts thereof found to be diseased, unsound, or otherwise unfit for food. This procedure pertains essentially to inspection prior to purchase, but in the case of live animals bought on the hoof it may be the inspection at receipt, or when applied to animals held after purchase, an inspection in storage. It is made at time of slaughter or as soon thereafter as practicable, and includes in sequence an examination of the head, viscera, and body and a secondary rail inspection. A final and detailed examination should be given all carcasses set aside (retained) at any point in the course of the post-mortem inspection.

2. When Conducted. Carcasses, derived from animals which have not passed the required official ante-mortem examination immediately before slaughter; those from emergency slaughter except as provided for in Army Regulations; and except carcasses slaughtered and dressed by a bona fide farmer on a farm which contain when offered for Army veterinary inspection the head and all viscera, other than the stomach, intestines and genito-urinary tracts attached; should be refused Army post-mortem inspection.

3. Identification of Parts. At slaughter and dressing, all parts, trimmings and blood intended for food purposes should be held in a sanitary manner, properly identified, until the official post-mortem inspection has been completed. Retained carcasses and parts, properly identified, should not be washed, trimmed or otherwise handled unless authorized by the veterinarian.

4. Equipment of Post-mortem Inspector. The veterinary post-mortem inspector should provide himself with the necessary facilities for inspection, including knives, sharpening steel, pouch, belt, suitable clothing, inspection stamp, inking pad, branding ink, note book, and indelible pencil. Boiling water containing 1 per cent of sodium carbonate

should be used for cleaning and disinfecting metal instruments. Bichloride of mercury solutions should not be used except as provided in cases of anthrax (See Part 1, F. Action). An antiseptic soap is suitable for disinfecting the hands. The veterinarian should observe the necessary steps in disinfection and require all employes to do likewise after handling diseased carcasses or contaminated implements. In case of anthrax prompt, definite action should be taken by the veterinarian in carrying out the provisions of Army Regulations (See "F. Action"). The veterinarian should see that all sanitary requirements are observed and that there is plenty of light for inspection purposes. The location, extent and character of all lesions of disease should be recorded along with identification data, later to be used if necessary on reports and returns (See Fig. 1.)

B. CATTLE

1. Head Inspection. The head inspection should be made if possible before the carcass is eviscerated. It includes:

An examination for icteric conditions of the adipose or other tissues, for epithelomias, bruises, maggot-infested dehorning wounds, horns recurved and growing into the head, deformities, and superficial lesions of actinomycosis.

A visual inspection of the tongue, tonsils and oral mucosae for actinomycosis, foot-and-mouth disease, necrotic or mycotic stomatitis, injuries, foreign bodies embedded in the tongue or Steno's duct, Cysticercus bovis, injected blood vessels, etc.

Deep palpation of the tongue for abscesses, actinomycosis, Cysticercus bovis, and foreign bodies.

When erosions of the tongue occur, especially in the transverse furrow, without characteristic ulceration, induration, lymph node involvement, or abscess formation, there is no rational cause for the rejection of the entire tongue, and after the removal of the erosions the remainder of the organ may be passed for food.

The internal muscles of mastication should be incised in such a manner as to split them in a plane parallel with the lower jawbone. The masseter muscles also should be incised, splitting the entire external layer between the outer and intermediate fasciae; this also should include the parotid lymph nodes, inspection of which is essential in old cows. The visual inspection of incised musculature is made to determine the presence of Cysticercus bovis.

An incision and examination of the submaxillary and postpharyngeal lymph nodes for tuberculosis, actinomycosis, and simple abscesses. Each lymph node should be incised in several places, as one incision would not permit an adequate inspection. If disease is found in the head, it, with the carcass and all its parts, should be retained and further appropriate measures taken as each individual case demands and as hereinafter described.

2. Miscellaneous Examinations. a. Legs. When legs are intended for edible purposes their handling should insure cleanliness.

b. Genito-Urinary Tract. (1) Male organs. The penis and testes, when present should be removed and rejected.

(2) Female organs. (a) Mammae. The mammae, if present, should be removed and examined for tuberculosis, milk flow, mammitis, and pus. When desired for food purposes, udders from cows used for breeding purposes only should be examined by palpation, and incisions made when necessary. Udders from dairy cows should be sliced into sections about 2 inches thick, then thoroughly inspected. This inspection should also include the supra-mammary lymph nodes. If pus or other objectionable material is permitted to come in contact with the carcass, the parts of the carcass thus contaminated should be removed and rejected.

(b) Uterus. The uterus should be examined for signs of pregnancy, recent parturition, acute or septic metritis, pyometra and other conditions. The size and development of the fetus, if present, should receive consideration. The genital organs, with the fetus and its membranes, if present, should be removed and rejected.

(3) Bladder. The bladder should be inspected for dark-colored urine, hemorrhages, or inflammation.

c. Caul. Inspection should be given the caul for pus and the "pearly" form of tuberculosis.

d. Body. Palpation and incisions when necessary in conjunction with a visual inspection should be given the hock and stifle joints, the precrural, internal iliac, and superficial inguinal or supra-mammary lymph nodes, as the case may be. Swollen hock joints and adjacent tissues of beef animals, especially old cows, should be examined carefully, in order that all cases of localized tuberculosis may be detected. It is also very important to make a careful examination of the lymph nodes which drain these tissues, especially the popliteal and precrural nodes, in order that the extent of the disease may be determined. Tubercular lesions frequently occur as calcified swellings with little

or no acute inflammation in the hock and stifle joint regions of old cattle. It therefore is desirable to make an examination by incision into the aponeurotic sheath in the region of the internal tuberosity of the tibia.

After evisceration, a perfunctory examination of the carcass should be made with special reference to color, odor, multiple abscesses, rectal hemorrhages, pus contaminations, cystic or abscessed kidneys, hematomas, emaciation; and for tuberculosis, adhesions, inflammations, and subserous hemorrhages of the parietal pleura and the peritoneum.

3. Viscera Inspection. a. Gastro-Intestinal Tract. This examination includes:

(1) Intestines. Palpation or incision of the mesenteric and colic lymph nodes for tuberculosis, the lesions of which should not be confounded with those of the Pentastomum denticulatum.

A visual inspection of the intestinal tract and visceral peritoneum for paratuberculosis, pentastomum foci, inflammatory conditions, injected blood vessels, hemorrhages, pus contaminations, tuberculosis, and prod-pole injuries of the rectum.

(2) Spleen. A visual survey of the spleen for enlargement, softening, abscesses, and tuberculosis.

(3) Stomachs. A visual examination of the stomachs for abscesses, pus contamination, inflammation, adhesions, hemorrhages, tuberculosis, and foreign bodies penetrating the reticulum.

b. Liver. Examination of the gall bladder is made for lesions of splenetic fever. The gall bladder should be rejected.

Incisions of the liver are made through the larger bile ducts, and adjacent to the spigelian lobe on the gastric surface for indications or the presence of liver flukes (Fasciola magna, or hepaticum). The bile ducts, upon massage toward the incision, may disclose the parasite. The nature of the blood in the veins should be noted. Sometimes pus in the bile ducts is due to a deeply embedded abscess. The portal lymph nodes are incised and examined for enlargement or tuberculosis. A thorough visual examination of the entire liver should be made for icterus, fatty degeneration, sclerosis, tuberculosis, actinomycosis, Cysticercus tenuicollis, echinococci, coccidiosis, hyperemia, adhesions, hemangiomas, pus contamination, and abscesses or scars resulting therefrom. This examination should be supplemented by deep palpation for abscesses. Various incisions, if necessary, may be made for abscesses, fatty degeneration, hemangiomas, or other conditions. Lesions of the caudal mediastinal lymph nodes sometimes obtain to a diseased liver.

In inspecting the liver or any other organ, the veterinarian should determine if some part is missing. If the part missing cannot be found, the entire organ should be rejected. The management of the establishment, if necessary, should be cautioned in this regard.

During unusual emergency, light-colored livers of dairy cows or pregnant animals in which disease is not evident or hepatogenous icterus present, and those bearing healed scars, yet wholesome, with no evidence of pathological alteration, may be passed for food purposes.

Livers showing infestation with Fasciola hepaticum, Fasciola magna, Dicrocoelium lanceatum, larval stages of Oesophogostomum radiatum and Linguatula rhinaria, echinococcus cysts and Cysticercus bovis, should be rejected. Livers affected with Cysticercus tenuicollis or presenting superficially small calcified nodules, or other minor lesions caused by this parasite, may be passed for food after the affected portions are removed, if this can be accomplished without excessive multilation; otherwise the entire liver should be rejected. Caseous or calcareo-fibrous nodules existing as sharply circumscribed formations in the liver usually indicate a parasitic origin. Their differentiation from lesions of tuberculosis in the liver usually can be made by the absence of any alterations in the hepatic lymph nodes.

c. Lungs. Incisions should be made in the left and right bronchial and the median and posterior mediastinal lymph nodes to determine tuberculosis or other disease or enlargement. A visual examination should be given the lungs for adhesions, pleuritis, pneumonias, liver flukes and other parasites, actinomycosis, tuberculosis, oidiomycosis, pneumonomycosis, hemorrhages, gangrene, etc. This should be followed by deep palpation. If necessary, incisions may be made in various places. Cattle lungs, intended for food purposes, should be inspected minutely to determine the presence of tuberculosis of the bronchial mucosa and for foreign matter in the air passages. The main bronchi and branches should be slit for these examinations. If objectionable foreign matter is present, the lungs should be rejected.

d. Heart. The heart should be given a visual examination of the surface, followed by a longitudinal incision through the wall of the left ventricle from the base to the apex, then through the interventricular septum. The blood from these cut surfaces and from the endocardium should be removed with the knife blade, after which they should be given a thorough visual inspection, followed by a palpation of the entire organ for evidence of Cysticercus bovis, tuberculosis, inflammation, degeneration, adhesions, gangrene, edema, and subepicardial and subendocardial hemorrhages.

4. Rail Inspection. a. Carcass. (1) Outside. The outside of each half of the carcass should be inspected for bruises, fractures, symptomatic anthrax lesions, dirt contamination, emaciation, anemia, icterus and grubs (Hypoderma bovis and lineata larvae). Carcasses showing grubs superficially located, or lesions caused by them, should be trimmed sufficiently to remove all parasites together with any tissues altered or discolored from such invasions. The prescapular lymph nodes should be palpated.

(2) Inside. The inside of each half should receive consideration: The vertebrae and sternebrae for tuberculosis, injected red bone marrow, and presternal calcifications; the parietal peritoneum and pleura for tuberculosis, adhesions, removal of pleura, inflammations, hematomas, fecal contamination, injected capillaries, subserous hemorrhages, pus contamination, and necrosis of retroperitoneal fat.

The diaphragm and its pillars should be examined for measles and exhaustion or other hemorrhages: then lifted up and their thoracic surfaces examined for tuberculosis. The ribs should be examined for fractures, tuberculosis, or pus conditions. The kidneys should be examined for consistency, injections, tuberculosis, abscesses and contamination. When any of the liver has been left attached adjacent to the right kidney, it should be removed and rejected. Frequently abscesses of the serosa occur in this region.

Examination should be given the sternodiaphragmatic, prepectoral, superior cervical, and caudal mediastinal (if left attached) lymph nodes. Examination of the cut surfaces of the musculature should be made for hemorrhages and measles. It should be ascertained if all inedible and rejected parts have been removed. This includes especially contaminations, as floor, fecal, or pus, also udders and bruises.

b. Hide. When conditions warrant, the hide may be examined for lesions of tuberculosis, actinomycosis or other disease or condition.

5. Final Examination. In the final inspection of carcasses a very thorough search should be made for all pathological conditions. Only rarely is it necessary to refer specimens from a retained carcass for laboratory examination, however, the veterinarian sometimes may encounter conditions wherein a supplementary Medical Department laboratory examination is essential. The following special conditions on the organoleptic final inspection of cattle carcasses should be considered as follows:

a. Tuberculosis. A careful survey should be given the head, viscera, and carcass as on routine inspection. The lymph nodes of the head and

viscera should be thoroughly incised and scrutinized. Incisions should be made in the lymph nodes of the sublumbar region, the deep inguinal, renal, mediastinal, sternodiaphragmatic, prepectoral, cervical, axillary, prescapular, precrural, and ischial lymph nodes; and the spleen, kidneys and adrenal glands. When lesions of tuberculosis are found in the cervical lymph nodes and the carcass is to be passed for food, after the head has been rejected, the prepectoral, neck, and superior cervical lymph nodes, together with adjacent adipose tissue, should be removed and rejected. Hide lesions also should be considered.

b. *Actinomycosis.* The final inspection routine is practically the same as that pursued for tuberculosis. When lesions of actinomycosis are found in the head, but not in the viscera, the incision of the body lymph nodes may be omitted. However, the final inspector should make a careful survey of the carcass, including palpation of the region of the body lymph nodes, for the detection of possible abnormal conditions. The body lymph nodes should be incised and examined when lesions of actinomycosis are found in the viscera. In some instances the lesions of actinomycosis are found only in the liver.

c. *Cysticercus Bovis Infestation* (*Beef Measles*). When a beef carcass is retained for measles, all the exposed musculature should be examined; also the external and internal muscles of mastication, tongue, heart, and the muscular portion of the diaphragm, including the pillars, should be carefully and thoroughly sliced to insure finding all cysts. Prior to inspection of the attached diaphragm, its peritoneum should be removed. Palpation for calcified cysts should precede the incisions. The muscular coat of the oesophagus should be examined. It is not considered necessary in this final examination to shred the liver.

d. *Icterus.* All carcasses retained for suspected icterus should be permitted to chill out for twenty-four hours before final judgment, which should be accomplished in natural light. In doubtful cases, after chilling, a decision may be reached sometimes by the condition of the bone marrow as shown by sawing through the fore shank. Due consideration should be given to the normal yellow color of fat found in certain dairy breeds and in animals fed on certain feed stuffs, as cottonseed meal; also icterus as due to splenetic fever and other diseases.

e. *Emaciation.* In the judgment of emaciation versus leanness, no set rule will cover all cases. The cause should be considered. Leanness may be caused by deficient nutrition, while emaciation which is characterized by organic and atrophic changes may be due to a prolonged febrile state or other diseased condition, or to senility. In

chronic wasting diseases as malignant tumors or leukemia, and in acute infections, emaciation may occur due to toxic substances produced by morbid processes and to defective nutrition. Emaciation may be encountered in progressive pernicious anemia, paratuberculosis, parasitic infestations and in senility due to diminished regeneration of worn out tissues. Its degree must be determined; also in doubtful cases, the effect of chilling temperatures for twenty-four hours.

In emaciation the bone marrow may or may not be of a darkened color and softened consistency; atrophic changes may occur in the spleen, liver or other glandular organs; serous infiltrations may obtain to the intra-muscular and subcutaneous connective tissues; the muscle fibres may be flabby; and a gelatinous infiltration may occur where normal adipose tissue should be present.

f. Suspects. Great care should be exercised in the final postmortem inspection of all suspects, especially animals unable to stand. This also should apply to emergency slaughtered animals.

C. CALVES

The routine and final inspections of calves simulates that for cattle except as otherwise noted. Examination should be made especially for foot-and-mouth disease, calf diphtheria, tuberculosis, abscesses, splenetic fever, blackleg, vaccinia, immaturity, anthrax, hemorrhagic septicemia, exhaustion, emaciation and Cysticercus bovis.

1. Fetus. Unborn or stillborn animals should be rejected. The undressed carcass of a fetus shows soft, untouched sole pads, remains of umbilical cord and umbilical vessels open and containing blood. The dressed carcass shows atelectatic lungs (if not artificially inflated), absence of coagulated milk in digestive tract, meconium, open urachus, gaping of the umbilical vessels, and undeveloped tissues.

2. Head Inspection. The submaxillary and postpharyngeal lymph nodes are incised for infections, especially that of tuberculosis. In calves over 6 weeks of age a careful visual examination for Cysticercus bovis should be given the exposed musculature.

3. Viscera Inspection. When splenetic fever is suspected the bladder and contents should be examined. The mesenteric and colic lymph nodes should be palpated. The intestines should be inspected for inflammations. Any indication of pyosepticemia neonatorum should be considered. The liver, including the portal lymph nodes, should receive the same inspection as beef livers for parasites, tuberculosis, and abscesses. The mediastinal and bronchial lymph nodes should

be incised with especial reference to tuberculosis, which in some instances may present the arborvitae appearance. The lungs should receive deep palpation and visual examination for tuberculosis, parasitic conditions, pneumonias, hemorrhages, etc. Lungs containing ingesta or other objectionable foreign material in the air passages should be rejected. The routine inspection of calves over six weeks old for the presence of Cysticercus bovis may be limited to a careful examination of the heart and such other surfaces as is practicable to examine.

4. Body Inspection. The outside of each carcass should be examined for arthritis, lesions of blackleg, fractures, parasites, and dirty hide. The inside should be inspected for bruises, fractured ribs, rachitis, adhesions, pleuritis, hemorrhagic musculature, immaturity, emaciation, abnormalities of the thymus, and other conditions. From the carcass of the male the testes should be removed and rejected. When there is evidence of bruising the skin should be removed. When infested with southern cattle ticks which are more than half grown, a carcass should not be removed from the establishment until the ticks or skin has been removed. (Also see section B, par. 5, chapter V.)

D. SHEEP AND GOATS

The following inspection procedures refer to sheep. The procedure for goats is essentially the same, the veterinarian considering conditions and diseases peculiar to the goat, and especially Malta fever and takosis.

1. Superficial Inspection. A visual survey of the outside of the carcass should be made to detect stains, abscesses, pus contamination, attached hoofs or pieces of skin, bruises, maggot-infested wounds, fractures, icterus, emaciation, anemia, herniae, sternal chondromas, scabies, dermatomycosis, burns, lip-and-leg ulcerations, foot-and-mouth disease, and foreign bodies embedded in the subcutaneous tissues, especially in the abdominal region.

The bones are palpated for the presence of fractures, the muscles for Cysticercus ovis and the lymph nodes for caseous lymphadenitis. A thorough deep palpation is given the hind legs, popliteal and precrural lymph nodes, back, sides, prescapular lymph nodes, forelegs and the superficial inguinal lymph nodes and penis or supramammary lymph nodes and mammae, as the case may be.

2. Body and Viscera Inspection. The uterus should be inspected for metritis, dead fetus, and advanced pregnancy or recent parturition. Genital organs should be rejected in their entirety, together with the

fetus if present. Care should be exercised to prevent rupture of the urinary bladder, or liberation of gastric contents.

The caul fat if desired as an edible product is inspected for Cysticercus tenuicollis, and fecal or floor contaminations. When Cysticercus tenuicollis infestation is slight, the cysts may be removed and the caul passed for food. If fecal or floor contaminations exist, the caul should be rejected. The identity of all viscera and parts should be preserved until the carcass has been finally disposed of.

After evisceration an inspection should be given the pelvic outlet for the presence of the anus, rectum, urinary bladder, fecal pellets and caseous lymphadenitis of the lymph nodes of that region. Palpation should be given the lymph nodes in the sub-lumbar region, and the kidneys for caseous lymphadenitis. Upon rejection of the liver, the region anterior to the right kidney should be examined and any portion of liver that remains should be removed. The spleen also should be removed. A thorough palpation of the inner abdominal musculature, of the diaphragm and of its pillars, should be made for Cysticercus ovis. Palpation should be continued over every part of the walls of the thoracic cavity. The parietal pleura should be examined for caseous lymphadenitis, pleuritic adhesions, and acute pleuritis; the ribs for fractures; and the mediastinal lymph nodes, if not removed, and the suprasternal lymph nodes, for caseous lymphadenitis. The veterinarian should determine if fecal contamination has occurred. Drainage of the thoracic cavity should be provided. The sternum should be split medially. A visual inspection should be given the interior of each carcass to detect exhaustion hemorrhages in the musculature, adhesions, icterus, and parasitisms. Odors if present should be noticed, especially those of parasitic icterohematuria.

a. Liver. The gall bladder should be inspected for lesions of parasitic icterohematuria, and the presence of fringed tapeworms (Thysanosoma actinioides). The liver should be inspected visually and palpated for Cysticercus tenuicollis, congestions, fatty degeneration, sclerosis, icterus, caseous lymphadenitis, and liver flukes (Distoma hepaticum). The bile ducts should be incised for fringed tapeworms and liver flukes. The portal lymph nodes should be examined for caseous lymphadenitis.

b. Lungs. Palpation or incisions should be made for caseous lymphadenitis, lung worms (Strongylus filaria), pneumonias, adhesions, abscesses, hemorrhages, and tumors. The mediastinal and bronchial lymph nodes should be palpated.

c. Heart. Inflammations, subepicardial hemorrhages, adhesions, and Cysticercus ovis may be found on visual examination, which should be supplemented by deep palpation and incisions for cysts.

3. Final Examination. All bruises on passed carcasses should be trimmed out during routine inspection, unless the establishment desires to chill the carcass in the retaining cooler prior to the trimming. Pus, fecal contamination, stains, and foreign bodies in the subcutaneous tissue should be removed with a knife. "Christmas dressed" carcasses, on which so-called "diamond dust" is used for ornamental purposes, should be considered as contaminated.

If a liver contains parasites not sufficient in number or kind to cause rejection, other conditions being favorable, the parasites may be trimmed out and the liver passed for food. Pleuritic or peritoneal adhesions and hemorrhagic diaphragms in a passed carcass should be removed and rejected.

a. Caseous Lymphadenitis. Body and visceral lymph nodes including the popliteal, ischial, precrural, prescapular, superficial inguinal (supramammary), internal iliac, sublumbar, cervical, suprasternal, mesenteric, hepatic, mediastinal and bronchial, should be incised or palpated; and the kidneys, liver and lungs thoroughly examined. Consideration should be given the condition of the carcass. In food carcasses all diseased lymph nodes and adjacent parts and the popliteal lymph nodes should be removed and rejected.

b. Cysticercus Ovis Infestation (Sheep Measles). The diaphragm and its pillars, the heart, tongue, and muscles of mastication should be detached, then palpated, and finally shredded with a knife, making a thorough search for cysts. Thorough palpation of the musculature of the carcass should follow.

c. Parasitic Icterohematuria. This is characterized by the following conditions in varying degree:—Spleen, dark, enlarged, friable, peculiar odor; liver and kidneys, bluish-black, with peculiar odor; gall bladder enlarged, walls thickened and hemorrhagic; bile thick, peculiar odor; lemon yellow color of adipose and muscular tissues; and occasionally dark red urine, gelatino-hemorrhagic infiltration of subcutaneous tissues, and superficial necrosis of abomasum, duodenum and rectum. About 5 per cent of the erythrocytes in the splenic pulp contain Piroplasma bursa.

In icterus there is no parenchymatous degeneration of the kidneys and spleen, no enlargement of the gall bladder and an absence of the odor peculiar to parasitic icterohematuria. Sheep of a yellow color due to breed or to feed, present normal organs and glands.

E. SWINE

1. Head Inspection. Various incisions are made into the cervical lymph nodes, especially the submaxillary, for the presence of arbor vitae or other tubercular lesions, actinomycosis, and abscesses. A visual examination should be given for Cysticercus cellulosae (pork measles), necrotic stomatitis, and gross skin lesions.

2. Skin and Body Inspection. Visual examination should be made for skin lesions of cholera and urticaria; granular eruptions; hemorrhages due to bites of lice; hematogenous, icteric, or melanotic pigmentations; pigmented moles or pigmentation of the legs and belly due to filth; discoloration of adipose tissue or skin due to feed or to uremia; scratches from tusks; bruises; hypostasis; erythema due to frosting of the skin, or to the live animal entering the scalding vat; frozen skin containing hair; tumors; sarcoptic and demodectic scabies; abscesses; hair; scurf; hoofs; contaminations; cooked skin; ringworm; necrosis of the skin; tuberculosis or actinomycosis of the mammae; "seedy" belly; emaciation; fractures; ascites; boars; recently castrated stags; scirrhous cord; heads dragged on floors; polyarthritis; and deformities.

3. Visceral Inspection. At evisceration, consideration should be given cryptorchids, hemorrhages into the hip joint or other muscular regions, pyemia, septic metritis, advanced pregnancy, recent parturition, dead fetus, urine contamination, and uremic or sexual odors. The "gut" bench should be kept clean, and jets of boiling and cold water should be available to sterilize the table, or to clean viscera contaminated so that a proper inspection can be made. The viscera inspection includes:

a. Spleen. Palpation of the spleen for tuberculosis, and a visual examination for hemorrhages, tumefactions, parasitic or other nodules simulating tuberculosis, and "sago" spleen.

b. Thoracic Lymph Nodes. Palpation of superior aortic, and incisions of bronchial lymph nodes for tuberculosis, or enlargements, and a visual inspection noting color.

c. Lungs. Palpation of lungs for tuberculosis, and abscesses; also should note pneumonias, pleuritis, adhesions, hemorrhages, tank water, blood from a "poor stick," strongylosis, and flukes (Paragonimus kellicotti).

d. Heart. Visual inspection of the heart for adhesions, inflammations, hemorrhages, tuberculosis and measles, and incision of the myocardium for measles.

e. Liver. Visual inspection of the liver for icterus; congestion; foreign material as sand or hair in the bile ducts; hemorrhages; tuberculosis; parasites as Cysticercus tenuicollis and Cysticercus echinococcus; hemangiomas; degenerations as amyloid, fatty, and albuminoid; sclerosis, adhesions, and enlargements. The gall bladder may contain calculi. Incisions of gastro-hepatic lymph nodes for tuberculosis, or enlargements.

f. Gastro-Intestinal Tract. Visual inspection of stomach, intestines, and mesentery for fecal contamination, adhesions, abscesses, tuberculosis, emphysema, calcification, parasitic nodules, hemorrhages, erosions, injections, and inflammations. Visual inspection of the mesenteric and colic lymph nodes for hemorrhages and palpation for tuberculosis.

g. Miscellaneous. If cholera is suspected the kidneys should be examined, and also the sternebrae, cutting through the same. Kidneys may be cystic or present tumors or parasites. Odor and color should be observed, and if necessary the inside of the carcass may be examined for tuberculosis of the serosa, hemorrhages, adhesions, inflammations, abscesses, injections, measles, and the presence of testes.

4. Final Examination. This includes the sectioning of the head and visceral lymph nodes and a visual examination of the carcass and viscera, also noting any odors present. When tuberculosis is found, the body lymph nodes may or may not be examined according to location or extent of the disease in the head, viscera and visible portions of the carcass.

a. Tuberculosis. A thorough examination should be given all cervical, bronchial, superior aortic, gastro-hepatic, mesenteric, colic and splenic lymph nodes by repeated incisions and visualization. The heart and lungs should be palpated, and incised if necessary. The liver should be examined and when the gastro-hepatic glands are affected it should be incised repeatedly.

The examination of body lymph nodes may be omitted when lesions of tuberculosis are limited to the cervical, or to the mesenteric chain of lymph nodes. However, the final inspector should make a careful survey of the pleural, peritoneal, and other surfaces for the detection of possible abnormal conditions, and when lesions are present he should see that the parts are properly removed and rejected.

An examination should be made of body lymph nodes of each carcass showing evidence of tuberculosis in both the cervical region and the viscera. An examination should be made of body lymph nodes

of carcasses showing evidence of tuberculosis in the mesenteric chain, together with disease in the viscera or elsewhere.

Inspection of the body lymph nodes should be conducted as follows: Incisions and visual inspection of the hock, superficial inguinal or supramammary chains, the precrural, internal iliac and sublumbar lymph nodes; inspection and removal of any superior aortic lymph nodes left in the carcass; removal of the inferior thoracic and prepectoral lymph nodes, and, if the head is affected, of all cervical lymph nodes with tissues immediately adjacent; and removal of the prescapular lymph nodes. In all instances inspection should be given split vertebrae, pleurae, kidneys, mammae, genitals, musculature, and the condition of the animal.

b. Hog Cholera. Examination should include the skin, lymph nodes, kidneys, bones, sternebrae, fat, lungs, and the gastro-intestinal tract.

c. Sexual Odor. When sexual odor is suspected, after chilling the carcass twenty-four hours, the heat test may be applied. This consists of placing samples of suspected meat and fat taken from the ham and diaphragm, into a covered container of fresh, cold water, heating the water to the boiling point, and noting the odor of the developing steam from time to time. Parts contaminated with urine from the bladder or prepuce should be rejected. Such parts also should not be used in the heat test.

d. Miscellaneous. Carcasses or parts passed for food should have all rejected and inedible parts removed. Food carcasses emerging from the final room should be thoroughly washed.

5. Rail Inspection. This is made of each food carcass before chilling and includes palpation of the superficial inguinal (supramammary) lymph nodes and a visualization of all surfaces.

The purpose of the rail inspection is to determine if carcasses are properly branded; also the presence of tag rings, hair, scurf, bruises, abscesses, melanotic changes, urticaria, yellow discoloration, erythema, injection, demodectic scabies, and other skin conditions. Consideration should be given the presence of the anus, internal bruises, fractured leg bones or ribs, or lesions of the ribs resulting from fractures, polyarthritis, sexual odor, uremia, adhesions of the pleura, bone or skin lesions of cholera, bone lesions of tuberculosis, and fecal, pus, blood or floor contamination. Sometimes contamination due to dust, rust, or oil from machinery, sawdust or scaling whitewash may obtain.

In shipper pigs a careful check should be made of the cervical lymph nodes, an inspection should be given for lard or kidney worms and the kidneys should be removed from their capsules and carefully examined.

All carcasses showing defects should be retained and disposed of according to Army Regulations (see "F. Action"). If possible, removable defects should be trimmed off under veterinary supervision before carcasses enter the cooler. Mammary glands which are lactating, indurated or containing simple abscesses, should be rejected. Abscesses if possible should be removed without opening them. "Buttons" due to healed rib fractures, should be removed.

F. ACTION

As discussed hereinafter, action, which has a general application, indicates from a sanitary standpoint the disposition of diseased carcasses and parts which may be encountered on post-mortem inspection.

1. Action Regarding Diseased Carcasses and Parts. Great care should be exercised to prevent transmission of contamination from diseased carcasses or parts by means of inspectors and employees or their equipment or implements. Immediately after the slaughter of an animal rejected for communicable disease the slaughtering premises and implements should be sterilized thoroughly with boiling water, and in case of anthrax or foot-and-mouth disease all parts, including hides, horns, feet, viscera, intestinal contents, trimmings, and blood, should be immediately incinerated or completely destroyed, and the killing bed and implements involved sterilized with a boiling bichloride of mercury solution 1–1,000, and then cleaned with boiling water.

The part of any carcass coming into contact with a rejected carcass or part or contamination therefrom, or with the place or implements of slaughter prior to their proper disinfection, should be rejected outright. In the event a contaminated part is not satisfactorily removed from the carcass under veterinary supervision within two hours after contact, the whole carcass should be rejected outright. Sufficient boiling water should be available for disinfecting tables, containers, and butchering implements, also antiseptic soap for disinfection of hands.

2. Outright Rejection. Carcasses should be rejected outright for food purposes when any of the following conditions are present:

Evidence of anthrax, foot-and-mouth disease, blackleg, splenetic fever, hemorrhagic septicemia, malignant epizootic catarrh, contagious pleuropneumonia, unhealed vaccine lesions, rinderpest, pyemia, septicemia, sapremia, toxemia, poisonings, parasitic icterohematuria of sheep, hog cholera, swine plague, Cysticercus cellulosae, suffocation,

hogs entering scalding vat alive, immaturity, stillborn or unborn animals, takosis, Malta fever.

Tuberculosis, actinomycosis, caseous lymphadenitis, melanosis, pseudoleukemia, sarcomatosis, carcinomatosis, Cysticercus bovis, Cysticercus ovis, or other parasitic infestation, when generalized.

Whenever any disease or condition as necrobacillosis, paratuberculosis, or white scours in calves progresses beyond the point of localization to that of toxemia, emaciation, degeneration of glandular organs, or other evidence of generalization.

When carcasses are so infected that consumption of meat thereof may give rise to meat poisoning. This includes all carcasses showing signs of either acute inflammation of serous membranes or lungs; puerperal, traumatic, or other septicemia or pyemia; acute diffuse hemorrhagic or gangrenous enteritis, gastritis, metritis or mammitis; traumatic pericarditis; phlebitis of umbilical veins; or any acute inflammation or suppurative condition associated with such systemic lesions as acute inflammation, swelling, or degeneration of kidney, liver, spleen, or lymph nodes, or marked pulmonary hyperemia or redness of the skin either singly or in combination.

Icterus with a parenchymatous degeneration of organs, and carcasses which show an intense yellow or green discoloration, or those which after chilling out for twenty-four hours do not lose such discoloration as shown by inspection under natural light.

The odor of urine or a sexual odor as shown by the heat test after chilling out for twenty-four hours.

Mange in advanced cases with emaciation or inflammatory involvement of the muscular tissues.

Manifesting suppuration or other infective arthritis in more than one joint.

Evidence of "cold" slaughter; or a history of rabies, tetanus, milk fever, railroad sickness or pyrexia obtaining at slaughter.

When too anemic or emaciated to produce wholesome meat or showing slimy degeneration of fat or serous infiltration of muscles. In doubtful cases of emaciation if upon proper chilling for twenty-four hours the tissues between the spinal processes remain gelatinous, the carcass should be rejected outright.

Showing signs of parturition or having given birth to young within ten days.

When badly or extensively bruised.

3. Rejection in Whole or in Part. Carcasses should be rejected in whole or in part, depending on the character of the lesions and the extent of involvement, by special conditions as follows:

a. Tuberculosis. (1) Food Carcasses. Well nourished carcasses showing slight, localized and calcified or encapsulated lesions of tuberculosis may be passed for food when such lesions are limited with no evidence of systemic involvement, provided the parts containing lesions are removed and rejected. This would include lesions as follows: When in one body cavity, two groups of visceral lymph nodes and one organ are involved slightly; or in addition to cervical lesions, two groups of visceral lymph nodes or one group of visceral lymph nodes and one organ are affected; when in one body cavity two groups of visceral lymph nodes are affected and in the other body cavity one group; or when cervical lesions are present in addition to those in one group of lymph nodes in each body cavity, and very slight lesions in the liver. The organs referred to in this paragraph include only the lungs and liver.

It is generally understood that eleven or less foci in a part or organ would be classified as slight infection, twelve foci as well marked, and more than twelve foci as extensive. However, consideration should be given whether lesions are evenly distributed or localized to a part. When calcified or encapsulated lesions are found in not more than two cervical lymph nodes of a carcass or two mesenteric lymph nodes they may be termed "slight." With reference to an individual lymph node, when less than one-half of the node is involved and the node is not enlarged, the lesion in slight. When less than one-half of a node is affected and the node is edematous or enlarged, or when one-half of a node is affected, the lesion is well marked. When more than one-half of the substance of a node is affected the lesion is extensive.

(2) Rejected Carcasses. Carcasses which reveal lesions of tuberculosis more severe or more numerous than those described under the preceding subparagraph, and poorly nourished carcasses showing tuberculosis in any degree, should be rejected outright.

Tuberculin reactors and animals showing pyrexia at slaughter should be refused post-mortem inspection. Outright rejection should be made of carcasses showing any lesions in serous membranes, hide, bones, joints, musculature, spleen, kidney, uterus, ovary, udder, testicle, adrenal gland, brain or spinal cord or their meninges; or in lymph nodes associated therewith; or in any body lymph node, other than slight, calcified or encapsulated lesions in the lymph nodes of the head region.

(3) Organ or Part. An organ or part of a carcass should be rejected outright when it or its corresponding lymph nodes contains lesions of tuberculosis, if it is adjacent to a serous membrane involved, or when it is contaminated by tuberculous material. When a carcass is passed for food and the lesions in the thoracic cavity are slight and limited to the lymph nodes, the heart may be passed, but the remainder of the thoracic viscera should be rejected. In a passed carcass, when the lesions in the abdominal viscera are slight and limited to the portal lymph nodes, the liver and portal lymph nodes should be rejected, but the stomach, intestines, caul, and mesenteric fats may be passed for food.

It is not necessary to treat with disinfectants, hides from cattle rejected outright for tuberculosis as the curing and tanning processes are thought to be sufficient, however affected hides should have the lesions removed and rejected prior to salting. For the treatment of hog skins from swine rejected for tuberculosis see "d. Hog Cholera and Swine Plague."

b. Actinomycosis. Generalized actinomycosis requires rejection outright. If in a well-nourished condition, and the lesions are localized, the carcass may be passed for food after the organs or parts affected are rejected. When affected, the head, including the tongue, should be rejected, except when the disease of the jaw is slight, strictly localized and without suppuration, fistulous tracts, or lymph node involvement, the tongue, if free from disease, may be passed; or, when the disease is slight and confined to the lymph nodes, the head, including the tongue, may be passed after the affected nodes have been removed and rejected.

c. Caseous Lymphadenitis. A carcass showing generalized caseous lymphadenitis should be rejected outright. This includes all those showing well-marked lesions in the viscera and skeletal lymph nodes; extensive lesions in any one part; a thin carcass showing well-marked lesions in the skeletal lymph nodes and slight lesions elsewhere; or a thin carcass showing well-marked lesions in the viscera and only slight lesions elsewhere.

d. Hog Cholera and Swine Plague. Carcasses of swine not marked as suspects or not coming from a lot containing hogs sick with hog cholera or swine plague should be rejected when acute or characteristic lesions or evidence of hog cholera or swine plague are found elsewhere than in the kidneys and lymph nodes; however, lesions in the kidneys and lymph nodes should be considered on a final decision. Carcasses

of hogs marked as suspects showing lesions, however slight, including those in the kidney or lymph nodes, should be rejected.

When intended for tanning or industrial purposes, the skins of swine carcasses rejected for tuberculosis, hog cholera or other communicable disease of man or of animals (other than those discussed in paragraph "1" above), should be immersed for not less than five minutes in a 5 per cent solution of phenol or liquor cresolis compositus in a specially prepared compartment under supervision of the veterinarian. Otherwise such skins should be tanked or denatured as described under "g. Denaturing."

e. Cysticercus Bovis Infestation. If a carcass is watery or discolored, or if infestation is excessive as shown by the presence of two or more cysts within an area the size of the palm of the hand on most of the cut surfaces of musculature when incisions are made, it should be rejected outright.

When infestation is limited to one degenerated dead cyst the carcass may be passed for food after removal and rejection of the cyst. In a slight or moderate infestation other than indicated above as determined by careful final examination as herein outlined, the carcass may be passed for food after removal and rejection of the cysts and surrounding tissues, provided the carcass and parts, properly identified, are held in cold storage or pickle for twenty-one days under conditions insuring proper preservation, and if the temperature does not exceed 15°F., the period of refrigeration may be reduced to six days. Otherwise, the carcass should be rejected outright.

f. Cysticercus Ovis Infestation. A carcass in which are found more than five cysts after thorough examination should be rejected. If there be not to exceed five cysts it may be passed for food, after the cysts have been removed and rejected.

g. Trichinella Spiralis. Inasmuch as it can not be determined definitely by any present known method of inspection whether muscle tissue of swine contains trichinae which are dangerous to health, no article of a kind customarily eaten without cooking should contain pork muscle tissue unless it has been subjected to heat so that all portions attain a temperature not lower than 137°F., or subject to refrigeration not less than twenty days at a temperature not higher than 5°F., or other approved curing treatment sufficient to destroy all live trichinae.

h. Parasites, General. When lesions of parasites not transmissible to man are localized or are of such character that their removal from

an organ or part may be facilitated without mutilation, after such removal and rejection the organ or part may be passed for food. If too numerous, if their removal would result in mutilation, or if the lesions render an organ or part unfit for food, rejection is required. In infestation with Multiceps multiceps, the carcass may be passed for food but the brain and spinal cord should be rejected. Organs or parts affected with hydatid cysts (Echinococcus), or flukes, should be rejected. Sheep livers infested with fringed tapeworms (Thysanasoma actinioides) should be rejected.

i. Tumors. Whenever a sarcoma or carcinoma involves an internal organ to a marked extent; affects the muscles, bones, or lymph nodes primarily or secondarily; is metastatic; or if secondary changes have occurred in the muscles, the carcass should be rejected outright. Whenever an organ or a part is affected it should be rejected.

j. Immaturity. Carcasses too immature to produce wholesome meat should be rejected. This includes those lacking general good muscular development; those whose muscles contain a serous infiltrate or appear water-soaked, loose, flabby, grayish in color and easily perforated; and those in which the retroperitoneal tissue adjacent to the kidneys is dirty yellow or grayish red, edematous, tough, and intermixed with flocculi of fat.

k. Miscellaneous. Carcasses of hogs affected with urticaria (diamond skin disease), Tinea tonsurans, Demodex folliculorum, or erythema may be passed after detaching the affected skin if the carcass is otherwise fit for food.

Any organ or part badly bruised, abscessed, or contaminated should be rejected.

Reference also should be made to part 8-h, chapter VIII.

G. DENATURING

Unsound carcasses and parts rejected because their use as foods would constitute a menace to health, if possible, should be denatured and destroyed (see 8-h, chapter VIII). Such products may be treated by cremation, destruction, and sterilization under steam pressure, sterilization by boiling or steaming of denatured products, destruction by sulfuric acid, disposal by proper burial, denatured by chemicals or other agents, or combinations of the above.

Such denaturing and destruction should be complete, efficient and accomplished under veterinary supervision. In any event where the

veterinarian cannot personally supervise the destruction of such unsound products, it is desirable that they be slashed with a knife and denatured by means of crude carbolic acid, cresol, finely powdered quick lime, fine sand, power distillate (see 3 c, chapter XIII) or other designated denaturant. For the treatment of hog lungs see chapter VIII, part 5, a, (8), (c). (Also see F. Action, par. 1 and 3 d).

Cremation may be accomplished in an open fire, cross trench or crematory. When closed tanks are used the denatured products should be subjected to 40 pounds steam pressure a sufficient length of time to completely destroy them for food purposes. When deep burial obtains, the parts should be slashed repeatedly and denatured effectively with quick lime.

In any denaturing of unsound products, the veterinarian should be guided by Army Regulations (also see sanitation, chapter III).

(*Permission United States Bureau of Agricultural Economics*)

FIG. 7. COMMON STEER CARCASS

CHAPTER VII

Products Inspection

A. GENERAL

1. *Definitions and Scope.* a. *"Products Inspection."* As pertaining to the Army veterinary service, "products inspection" includes all inspection procedures, organoleptic or laboratory, other than ante- and postmortem, applied to food supplies of animal origin. These in part are enumerated as follows: beef, veal, mutton, goat meat, pork, poultry, rabbits, fish, game and other meats, oysters, and other marine products, eggs, milk or cream; whether fresh, chilled, frozen, cured, desiccated, comminuted, canned or otherwise processed or prepared in any manner, including all food supplies of which they form an essential part, and all products, preparations or parts derived therefrom; rendered or prepared fats of animal origin as lards, lard substitutes or compounds, oleomargarin and butter; also condensed milks, powdered milks, malted milks and others. The terms "food supplies," or "supplies" as used in this context apply to supplies, products, etc., of animal origin as defined in this paragraph.

Veterinary inspection procedures include the sanitary source of all food products of animal origin intended for troops; their selection; grading for purchase; the initial inspection and reinspections of products during their progress from original contact with the military service to their final disposal by issue to the troops; the sanitary supervision of the various processes involved in chilling, freezing, curing, smoking, pickling, drying, canning, rendering, manufacturing, branding, labeling, weighing, packing, shipping, and other manipulation of products; and the investigation of the source, nature, and prior inspection of all products and of all other substances and ingredients used in their preparation, including dyes, coloring matters, condiments and flavoring substances and the ingredients of inks used for stamping them.

b. *Product.* The term "product" as used in this text relates to a food substance derived from a food-producing animal or other animal food source, and intended to be supplied to the consumer, singly or in combination with other food substances, either in its natural state

or as affected by any process designed to facilitate its preservation, or handling or to improve its appearance or palatability.

All ingredients and substances entering into the preparation of products should be sanitary, fit for human food and should comply with all pertinent pure food laws and other official requirements. Products should not contain any added chemical or preservative not authorized, or any substance which might impair their wholesomeness.

c. Reinspection. Reinspection implies a prior examination which at initial origin, and subsequent slaughter or manufacture have passed official inspection of the Army veterinary service, Department of Agriculture, or other official and competent agency when approved.

d. Scope of Products Inspection. All food supplies intended for use by troops, including carcasses, parts, organs, cuts, trimmings or other raw product, manufactured and finished products should be reinspected as often as may be necessary after slaughter, during or after manufacture, on hanging floors, in chill rooms, freezers, warehouses, storerooms, also in cutting, sausage, curing, canning, rendering, or other compartments wherever products are manufactured or otherwise handled, at loading and unloading docks, on receipt at, while in storage in, and at time of issue from, any establishment in order to ascertain if fit for food, whether properly stamped or labeled, if false or misleading labels are used, if all inedible or rejected parts are removed, if deterioration has taken place, or if contamination, adulteration, or other objectionable or insanitary conditions obtain.

Since products inspection especially concern themselves with the sanitary origin, soundness and quality of the authorized, specified materials used, the processes to which they are subjected and their subsequent condition as finished products, it is evident that the various procedures involved are extremely broad in their requirements, covering as they do all the steps between the initial acquirement or origin of the products, their subsequent manufacture, the post-mortem inspection of carcasses immediately following slaughter and the time when the supplies are received by the troops. They are frequently a repetition of similar procedures under slightly varying conditions. They are closely concerned with sanitary requirements both as to the various steps of manufacturing processes and the conditions under which the supplies are stored and transported. They are likewise intimately involved with specification requirements. It is not the intent of this text to prescribe specification requirements, and references thereto are merely for the purpose of amplifying and clarifying the sanitary re-

quirements in each instance which frequently take precedence, parallel or overlap. Under succeeding chapters, under the headings of different products, are discussed the main points covering the technical procedures of products inspection, together with their application to inspections prior to purchase, on any receipt, during shipment, in storage and at issue to troops.

2. Authorized Ingredients. All ingredients and substances entering into products should be of sanitary origin, sound, clean, wholesome, fit for human food and complying with the sanitary requirements of the Surgeon General, also there is considered the purchase requirements, and all Federal pure food laws and those of States or Countries, concerned.

Approved dyes may be mixed with prepared fats, as lard and compound. Dyes for coloring sausage casings should not penetrate into the meat product contained therein. Substances which have been approved for dyeing casings or to be added to prepared fats are as follows:

Annatto and tumeric.

Coal-tar colors:

Red shades—107 Amaranth, 56 Ponceau 3 R, 517 Erythrosine.

Orange shade—85 Orange I.

Yellow shades—4 Naphthol Yellow S, 94 Tartrazine, Yellow A.B., Benzeneazo-b-napththylamine, Yellow O.B., Orthotolueneazo-b-naphthylamine.

Green shades—435 Light Green S.F. Yellowish, 433 Guinea Green B.

Blue shade—692 Indigo disulfoacid.

The numbers preceding the names refer to those of colors listed in the 1904 edition of the Schultz Julius Systematic Survey of the Organic Coloring Matters. Products artificially colored should be labeled "artificially colored."

The following have been approved for adding to meat products: Common salt; sugar; wood smoke; cider, wine, malt, sugar, glucose, or spirit vinegars; pure spices, saltpeter, and nitrate of soda. Benzoate of soda may be added to meat products, but such products should be labeled to show the presence and percentage amount of such benzoate of soda. Bicarbonate of soda and fuller's earth may be used in the preparation of fats, and sal soda or lime used in the cleansing of tripe, provided they do not impair the quality of the meat and are eliminated during further process of manufacture.

3. Branding. All supplies inspected and passed under the provisions of Army Regulations relating to the veterinary service, should be

stamped or otherwise properly marked by the veterinary officer at the time of inspection. Only approved standard stamps and inks should be used on products. Copper boxes, brushes, inking pads and dyes should be kept clean and free from contaminations. Stamps should be retained in the possession of the inspecting veterinary officer and when they become unserviceable should have the lettering effaced.

One approved branding ink for meat brands was made as follows:

Ingredients	*Amounts*
Pure water	22.5 gallons
Pure grain alcohol (not denatured)	19.0 gallons
Sugar, granulated	50.0 pounds
Methyl violet	5.0 pounds

In lieu of the sugar, 62.5 pounds of corn syrup or glucose may be used.

Preparation: Dissolve the sugar in the water, add the alcohol, add the dye, stir well and allow the solution to stand twelve hours before using. Keep in well stoppered clean bottles (See Fig. 1.)

The veterinarian should be familiar also with the standard markings for subsistence packages for products, the required specification markings and all other official requirements for labeling and marking products of animal origin.

If upon a reinspection, a product is found to be other than fit for food, any Army veterinary inspection stamp or mark should be noted, then removed or defaced by the veterinary officer making such reinspection, and the product rejected for the use of troops. In so far as practicable meats or meat products derived in whole or in part from cattle, calves, sheep, goats, or swine should be refused reinspection unless bearing marks of prior Army or United States Bureau of Animal Industry veterinary inspection, or of other competent and approved sanitary agency.

4. Laboratory Examinations. When adulterations, fraudulent substitutions or labeling, unauthorized preservatives, inedible, deleterious or poisonous substances, or undesirable or pathogenic organisms or parasites, are suspected in any food products, samples should be selected and forwarded to the designated Medical Department laboratory for analysis in accordance with Army Regulations.

Samples of meats and products, water, dyes, chemicals, preservatives, spices, or other articles used in any establishment accepting Army meat inspection should be made available without cost for chemical or technical examination as often as may be deemed necessary by the veterinary officer making the inspection.

CHAPTER VIII

Products Inspection (continued)

B. FRESH MEATS

1. General. As discussed in this section, fresh meats will include beef, veal, lamb, mutton and pork whether unchilled, chilled or frozen. Consideration is given carcasses, wholesale cuts, offal and trimmings as to classes, grades and methods of grading, commercial production, disposition, Army requirements of the Surgeon General as to sanitation, the purchase requirements of the Quartermaster General, the Army Veterinary inspection procedures, both sanitary and for purchase and the handling, storage and shipment of fresh meats. Such fresh products as poultry, eggs, fish and sea foods and fresh milk and cream are discussed in separate chapters. For other fresh products as game, horse meat, etc., the Army Regulations and standard American text books concerning these products should be consulted.

2. Fresh Beef. a. Offal. (1) General. The production of carcass beef has been discussed in "Cattle Slaughter." Carcass beef consists of the two sides including the kidneys, kidney and pelvic fats, the muscular portion of the diaphragm and its pillars and the heart and neck fats. Offal as covered herein includes the blood, hide, legs, head, genito-urinary organs, the adbominal, thoracic and neck viscera, the tail, adrenal glands, spinal cord, killing floor trimmings, and the fats and kidneys from cutting cattle and those which have been "boned out." Offal consists of edible, inedible and pharmaceutical products. The cheek meat, tail and thymus gland are known as "Fancy Meats."

The disposition and utilization of the different offal parts are largely controlled by commercial demand. Products which ordinarily would be used as edible, due to some economical factor or lack of demand may be converted into tallow or tankage. Others are used in the pharmaceutical trade.

In the living animal, ductless glands physiologically affect or control certain vital functions of cells, tissues and organs through elaborated internal secretions carried by the blood stream. To correct certain derangements and pathological conditions due to endocrine glandular

(Permission Swift & Company)

Fig. 8. Chicago Commercial Cuts of Beef

insufficiency, to awake dormant or impaired glandular function and to overcome physiological antagonisms, the medical and veterinary professions use certain preparations of tissues and glands, in desiccated form, as extracts, and soluble for hypodermic use. Some of these preparations give a definite physiological action upon being administered to an individual, for others a vague or doubtful action results. It is not an easy matter to standardize gland products. Some are assayed chemically or physiologically. Where this is impossible, they may be freed from fat and extraneous tissues and dried to a definite moisture content. Upon collection on the killing and offal floors, these glands are handled with great sanitary care, keeping them clean and chilling them properly and quickly. If they are to be used within twenty-four hours, they are packed in ice and held at about 32 to 36° F. If held for a longer period they should be kept at about 15° F. in open containers, protected from contaminations. These glands are discussed further in following sections.

(2) Blood. A small quantity of blood is used for medico-pharmaceutical and laboratory work, some is saved for edible purposes (see "Cattle Slaughter"), but the bulk is made into inedible products. In a raw state blood is rarely used. It is sometimes a carrier of disease producing germs and animal parasites. Blood decomposes quickly. It enters into the manufacture of blood sausages and beef extract and when so utilized should be handled in a sanitary manner and as expeditiously as possible. The regulations state that blood should not be used for food purposes unless it is fresh, sound, derived from animals free from disease and is collected and handled in such a manner as to prevent contamination. Blood albumen is collected by centrifuging or clotting the blood and, after drying, it is used in weather proofing aeroplane wings, in ply wood manufacture, print cloth, and tanning. Blood is quite extensively cooked, pressed, dried to a moisture content of 8 to 10 per cent, ground, and then sold on its ammonia basis (16 to 18 per cent) for fertilizer. It is also dried, put through a 40-mesh screen and used as blood meal for live stock food. Coarse, dried blood is used for poultry food. Blood also is used as a plaster retardent in making stucco. Cattle yield on the average about 58 pounds of fluid blood per carcass, from which may be prepared 8 pounds of dried blood with a moisture content of $8\frac{3}{4}$ per cent.

(3) Hides. (a) General. The removal and handling of cattle hides prior to their receipt in the curing or hide cellar have been discussed in "Cattle Slaughter." Upon their receipt in the hide cellar,

hides are reinspected, graded, weighed, trimmed and then cured. They are then sold to tanners.

(b) Reinspection. A good hide should be of proper pattern, dry, clean, and free from such defects as blood, dirt, mud, manure, flesh, fat, sinews, udders, tail bones, dew-claws, cuts, scores, heavy brand marks, and grub and tick holes.

(c) Grading and Weighing. The average weight of the hide from a 1000 pound steer is 65 pounds.

Classes of Hides

(United States Department of Agriculture, Farmers' Bulletin 1055)

GRADES

Grubs. During certain times of the year, hides and skins often are damaged by grub holes and because of this a selection or grading based on the number of grub holes is generally made during the grubbing season. Packer hides with fewer than 5 grub holes are graded as No. 1, while those with 5 or more are graded as No. 2. The grubbing seasons are as follows: On Texas steers and branded cows, from November 1 to June 1; on Colorados from December 1 to June 1; on native steers (including "spreadies"), "butt-brands" and native cows, from January 1 to June 1.

Hair slips and cuts. Packer hides are graded as No. 1 except when there are hair slips or a cut in the body of the hide which can not be trimmed out without spoiling the pattern. Such hides are classed as No. 2 or as glue stock, depending upon the extent of the damage. A No. 2 hide generally sells at 1 cent a pound less than a No. 1 hide of similar class and weight.

CLASSES

Native steers are unbranded steer hides, native meaning simply unbranded. They are selected as follows and are sold as such regardless of place of origin.

Spready native steers are steer hides free from brands, weighing 60 pounds and up and measuring 6½ feet and over just behind the brisket. From June to December, inclusive, they are sold as No. 1 only. During January to May, inclusive, they are sold on a grub selection. The Koshers of this selection may be sold on the same measurements, or 6 feet 8 inches and over, according to custom.

Heavy native steers are heavy, unbranded steer hides, weighing 60 pounds and up. They are graded No. 1 and No. 2.

Light native steers are unbranded steer hides weighing from 50 to 60 pounds. They are graded as No. 1 and No. 2.

Extreme light native steers are unbranded steer hides weighing from 25 to 50 pounds. They are graded as No. 1 and No. 2.

Texas steers are small, close-pattern, plump, branded steer hides. Originally they were from cattle coming from the ranges of Texas and vicinity, but now are sold as such regardless of place of origin. At Fort Worth, however, all branded steer hides are classed as Texas steers.

Heavy Texas steers are specially selected, branded steer hides weighing 60 pounds and up. They are graded as No. 1 and No. 2.

Light Texas steers are specially selected, branded steer hides weighing from 50 to 60 pounds. They are graded as No. 1 and No. 2.

Extreme Light Texas steers are specially selected, branded, steer hides weighing from 25 to 50 pounds. They are graded as No. 1 and No. 2.

Butt-branded steers are steer hides which carry one or more brands on the rump and are sold as one class without regard to origin.

Heavy butt-branded steers are butt-branded steer hides weighing 60 pounds or over. They are graded as No. 1 and No. 2.

Light butt-branded steers are butt-branded steer hides weighing from 50 to 60 pounds. They are graded as No. 1 and No. 2.

Extreme light butt-branded steers are butt-branded steer hides weighing from 25 to 50 pounds. They are graded as No. 1 and No. 2. Selection is seldom made for this grade, as they are usually sold in with extreme light Texas steer hides or with light butt-branded hides.

Colorado steers are western side-branded steer hides generally from range cattle and usually are more spready and less plump than the Texas steer. They are so classed irrespective of their origin.

Heavy Colorado steers are western side-branded steer hides weighing 60 pounds and up. They are graded as No. 1 and No. 2.

Light Colorado steers weigh from 30 to 60 pounds. They are quoted as No. 1 and No. 2.

Native cows are unbranded cowhides.

Heavy native cowhides weigh 55 pounds and up. They are graded as No. 1 and No. 2.

Light native cowhides weigh from 25 to 55 pounds. They are graded as No. 1 and No. 2.

Branded cows are both butt and side-branded cowhides. They are not selected on a weight basis, and are graded as No. 1 and No. 2.

Native bulls are bull hides free of brands. They are not selected on a weight basis, and are graded as No. 1 and No. 2.

Branded bulls are branded bull hides and are sold flat for all weights 25 pounds and over. They are graded as No. 1 and No. 2.

"Koshers" or "cutthroats" are hides and skins from "koshered" cattle or cattle killed according to the requirements of the Jewish religion. They are classed and graded as other hides and skins, but usually sell for one-half cent a pound less, because of the marred pattern due to cutting the throat crosswise instead of lengthwise.

Classification of Cured Hides

(*Packers' Encyclopedia*)

Spready native steers, not less than 6 feet 6 inches in width.
Heavy native steers, 60 pounds and up.
Light native steers, 50 pounds to 60 pounds.
Extra light native steers, 25 pounds to 50 pounds.
Kosher native steers, same as above.

Heavy Texas steers, 60 pounds and up.
Light steers, 50 pounds to 60 pounds.
Extra light steers, 25 pounds to 50 pounds.
Butt-branded steers, 60 pounds and up.
Butt-branded steers, 50 pounds to 60 pounds.
Butt-branded steers, 25 pounds to 50 pounds.
Kosher butt-branded steers, 60 pounds and up.
Kosher butt-branded steers, 50 pounds to 60 pounds.
Kosher butt-branded steers, 25 pounds to 50 pounds.
Colorado steers, 60 pounds and up.
Colorado steers 50 pounds to 60 pounds.
Colorado steers, 25 pounds to 50 pounds.
Kosher Colorado steers, 60 pounds and up.
Kosher Colorado steers, 50 pounds to 60 pounds.
Kosher Colorado steers, 25 pounds to 50 pounds.
Heavy native cows, 55 pounds and up.
Light native cows, 25 pounds to 55 pounds.
Kosher heavy native cows, 55 pounds and up.
Kosher light native cows, 25 pounds to 55 pounds.
Branded cows, all weights over 25 pounds.
Block cows, usually 55 pounds and over.
Native bulls, all over 25 pounds.
Branded bulls, all over 25 pounds.

(d) Trimming. Cattle ear hair is saved and disposed of to brush makers. The ears are split to enable them to flatten out. The switches are removed about 15 inches from the tail butt, washed in cold water, immersed in saturated brine twelve hours, then cured in dry salt and used for curled hair in upholstering and in brush making. Hide fats, fleshings, sinews, etc., are removed and go into inedible tallow, tankage and glue. Dew-claws are made into fertilizer and glue. Hide trimmings are made into glue.

(e) Curing. This operation should receive close attention in order that hides will not be spoiled for the manufacture of leather. Brine curing of hides is seldom practiced and is not productive of the best results. Hides are cured with coarse dry salt, in piles about 3½ feet high.

A thin layer of No. 2 crushed rock salt is sprinkled on the cellar floor. A layer of hides is then spread hair side down over the salted floor, care being taken to smooth out any folds or wrinkles. These hides are sprinkled well and evenly with salt, about 40 to 50 pounds per hide. Another layer of hides flesh side up is spread over the first layer, then a layer of salt, etc., until the pile is built up. Hides are cured in 30 to 40 days. The summer shrinkage is about 18 per cent,

winter shrinkage 12 to 15 per cent, and the average for all shrinks is about 14.75 per cent.

Bull hides and those carrying a quantity of manure require more salt. Slipped hair on a hide is due to insufficient salting and results in a No. 2 hide. The temperature of the curing cellar should be about 55° to 60°F. The limits are 40° and 75°F.

Slunk (unborn calf) skins, if sufficiently mature, are placed in a weak brine twelve hours, hung to dry, cured in fine salt and used for leather.

General Information

(*Packers' Encyclopedia*)

Packer hides:

Average weight, green	60 pounds
Average weight, cured	51 pounds
Average length	7 feet
Average width	6 feet
Space required in pack	1 cubic foot
Space required on floor	40 square feet
Average height of pack	3½ feet
Salt used in curing per hide	40 pounds
Time required to cure	30 days
Average shrink	15 per cent
Temperature of cellar	55°F.

Grubbing Season: Branded Cows, November 1 to June 1; Texas, November 1 to June 1; Colorados, December 1 to June 1; Bulls, not grubbed; balance, January 1 to June 1.

Spread is measured just behind the front legs; it refers to heart girth.

(4) Legs. Usually cattle legs are removed directly from the killing floor to the bone house. Here the sinews (ligaments and tendons) are removed and sent to the glue house (see Chapter XIII). The hoofs are steamed or scalded and the toes pinched off. Hoofs are sorted into white, striped and black classes. They are dried on trays by means of artificial heat. No. 1 quality whites weigh about 22 pounds per 100 pieces, No. 2 quality whites weigh 16 to 20 pounds and must average 18 pounds per 100 pieces. White hoofs are used in the comb and button industries. Striped and black hoofs are calcined 8 hours in a steam drier and ground into hoof-meal fertilizer.

The bones from cattle feet are made into neatsfoot oil, glue and bone products. The shins (shafts of the large metacarpal and large metatarsal bones) are sawed out. The extremities, after removal are known as knuckle bones. They are sorted into piles of shin bones and knuckle bones, washed, then thoroughly cooked in water in open

vats at 180° to 185° F. for eight to twelve hours. The exact time is determined by the appearance of the bones. If greasy the cooking is prolonged, if too brittle the time is reduced in cooking subsequent lots. Frequently flat shin bones require extra cooking. The grease is skimmed off and recovered as neatsfoot stock (see Chapter XIII). The bone liquor is used as tank water from which is recovered either glue or stick which goes into fertilizer. The shin bones are cooked several times to remove the grease and glue liquor. They are then washed and placed on racks and air-dried when they are known as "hard bones." Flat shin bones are produced from the fore legs and round shin bones from the hind legs.

GRADES OF SHIN BONES

(*Packers' Encyclopedia*)

Flat shin bones:
- Heavy flats, 35 pounds average per 100 pieces.
- Light flats, 28 to 35 pounds per 100 pieces.
- Cull stock under 28 pounds.

Round shin bones:
- No. 1, 50 pounds average per 100 pieces.
- No. 2, 40 pounds average per 100 pieces.
- Culls, under 38 pounds per 100 pieces.

Shin bones are used for knife handles, buttons and novelties. The knuckle bones along with the foot bones are sent to the glue house for the manufacture of glue. They are then crushed, ground into bone meal and used in stock food, fertilizer or for case hardening steel.

Sinews and bones when saved for edible purposes may be utilized in the manufacture of gelatin (see Chapter XIII).

(5) Head. (a) General. After the Army veterinary post-mortem inspection, rejected heads are disposed of according to Chapter VI. Heads are sometimes dressed as "barbecue" heads with the skin left on. These heads should be thoroughly washed after the veterinary inspection. Heads passed for food usually are separated into various parts as described in the following paragraphs.

(b) Tongue. When cattle are headed the gullet should be cut sufficiently long and left covered with fat. The fat covering the back of the tongue should not be removed. The tongue should be detached promptly from the head. The hyoid bones are fractured with an ax and the tongue disengaged from the jaw bones, being careful to avoid cutting into the tongue as any cut would depreciate its value. "Long Cut" tongues contain the pharynx, larynx and 3 to 4 tracheal rings, and weigh 5 to $6\frac{3}{4}$ pounds. Short cut tongues usually include the pharynx and larynx and weigh $3\frac{1}{2}$ to 5 pounds. Canner tongues

are trimmed close without any laryngeal cartilages remaining attached, and weigh 2 to 3½ pounds.

The pharynx is split open, ingesta removed, the tongue washed in lukewarm water, rinsed off in cold water, and the tonsils, salivary glands and any abrasions or foreign material imbedded in the dorsal furrow (hair pocket), are removed. The tongue is trimmed carefully. The trimming may be completed after chilling. Lean tongue trimmings and mutilated tongues go into sausages, clean fat trimmings and salivary glands into tallow; while tonsils, dirty fats and rejected trimmings go to the inedible tank. The tongues are washed thoroughly and hung on a rack. A veterinary reinspection is given them. Tongues which pass this examination are branded with the inspection stamp and sent to the cooler where they are chilled and graded. A few tongues are sold to the trade fresh, some after a forty-eight hour chill go to the pickle cellar where they are cured, then smoked. Tongues are also cooked and canned. Pigmentation is found normally in some tongues. They may be spotted or entirely black.

The parathyroid gland is recovered from the root of the tongue. Its function during life appears to be the retention of an adequate amount of calcium in the tissues. A desiccated substance manufactured from it is used along with calcium salts in muscular spasms and tremors, deranged nervous control and tetany following its surgical extirpation; in certain forms of eclampsia, chorea, varicose ulcer and osteomalacia, tuberculosis, or other conditions associated with calcium impoverishment.

(c) Horns. Horns are sawed from the skull. They are then sent to the bone house where they are cleaned and graded according to size, condition, markings and color. They may be placed in a warm room to dry or fresh horns may be heated in a vat with water, to facilitate removal of the piths. After the horn piths are loosened they are removed, dried and go for glue stock. Horn tips of No. 1 quality are sometimes sawed off and sold separately. Horns enter into the manufacture of combs, hair pins and other hair ornaments; into button manufacture or go for glue stock or fertilizer according to grade.

GRADES OF CATTLE HORNS

(Packers' Encyclopedia)

Steer horns No. 1, 100 pounds average per 100 pieces.
Steer horns No. 2, range from 65 to 80 pounds, average 70 pounds per 100 pieces.
Steer and cow horns No. 3, range 30 to 65 pounds per 100 pieces.
Bull, crab and cull horns are graded No. 4.

(d) Cheek Meat. The cheek meat is loosened from the lower jaw, which is then pulled loose from the head. This meat, also the lips, head meat and sometimes the hard palates are removed from the head, chilled in ice water, washed, spread on trays and taken to the chill room. They may be sold fresh as sausage or canning meat, or may be cured, made into sausage or go into canned products. Hard palates sometimes go into glue stock. The salivary glands and lymph nodes are used for sausage or tallow.

The parotid salivary glands may be trimmed from the head when the cheek meat is removed, and used in the manufacture of parotid gland preparations for the pharmaceutical trade, being prescribed in certain forms of digestive disturbances due to deficiency in saliva.

(e) Brain. The skull is split by hand or by a power-driven knife to remove the brain. The brain coverings, meninges and all attachments are disconnected and the brain is lifted out. The pineal and pituitary bodies if desired for pharmaceutical use are removed at this time.

Brains are placed into pans with free drainage and sent to the cooler as soon as possible. Brains from cattle which have been stunned with a hammer usually are more or less hemorrhagic and must be handled carefully and quickly to prevent deterioration. Some of the badly "clotted" brains are washed in cold water and canned. Those which are not hemorrhagic or bruised are chilled quickly, packed in paper-lined boxes and sold fresh. If not intended for immediate use they are packed in tin pails and frozen in a sharp freezer. Brains from kosher killed cattle, seldom are hemorrhagic and are very desirable. Brains are sometimes used in sausages and in potted meats.

Pineal Body. The pineal body or epiphysis cerebri is a small ovoid or fusiform protuberance three-fourths of an inch long, situated dorsally in a recess between the lobes at the base of the cerebrum. When saved from young cattle it is removed, placed into ice water to chill, drained and placed under refrigeration. It is desiccated and used experimentally in cases of retarded somatic and sexual development.

Pituitary Body. The pituitary body or hypophysis cerebri is a small oval discoid structure situated in a deep fossa of the sphenoid bone and connected with the base of the cerebrum. It is divided into an anterior and posterior lobe. The anterior lobe secretions promote somatic and sexual development in the young male. Hypersecretion may result in gigantism in preadolescent individuals and in acromegaly in adults. The posterior lobe secretions may promote female sexual development, control carbohydrate metabolism and stimulate smooth

muscle fibres. Deficiency causes muscular atony and dystrophy and disturbed carbohydrate metabolism with obesity. In case of both anterior and posterior lobe deficiency, adipose genital dystrophy may result. Three preparations are made from the pituitary body; a desiccated form from the anterior lobe, an extract is solution (Pituitrin) from the posterior lobe, and a desiccated preparation of the entire gland. Pituitrin is useful in cases of uterine inertia and in surgical shock.

A physiological saline extract of cattle brains is used as a local application in hemorrhage associated with true hemophilia and for acute internal hemorrhage.

(f) Skull and Lower Jaw. Heads to be used in food products should be split and have the bodies of the teeth, the turbinated and ethmoid bones, ear tubes and horn butts removed. These latter go into the inedible tank. The back edible portion of the lower jaw and the skulls which have been trimmed free from the inedible parts, are trimmed and washed in cold water, care being taken to remove all blood and contamination. They are cooked in an open vat, in water heated by means of steam. After cooking and settling, a high grade edible tallow is recovered by skimming. The cooking liquor goes for "tank water" and is made into glue and "stick." The bones are dried for commerce, and made into bone meal for poultry, rendered into glue and bone products or ground for fertilizer. The skulls may be crushed, put into pressure tanks, cooked eight hours under a live steam pressure of 40 pounds, when the water is drawn off, recooked, and subsequently evaporated into glue. The grease is recovered, and the bones freed from excessive water and grease by hydraulic pressure, are dried and pulverized into bone meal containing about 30 per cent bone phosphate of lime.

A few cattle eyes sometimes are saved for scientific dissection purposes in educational institutions.

(6) Genito-Urinary Organs. (a) General. The genito-urinary organs include the ovaries, uterus, vagina and udders of the female; the penis and testes of the male, and the kidneys and bladder. This class also includes fetuses (slunks) and their membranes.

(b) Ovaries. Ovaries of pregnant cows may be saved for the preparation of three substances. A preparation of the whole gland (ovarian substance) is indicated in natural or surgical hypo-ovarism at puberty and the menopause, and in eunuchoidism. Ovarian residue (ovarian substance minus the corpus luteum) is indicated in functional

sterility, amenorrheas, oligomenorrheas and in dysmenorrheas. Corpus luteum extract is indicated in case of hyperemesis gravidarum, in sthenic cases of delayed or scanty menstruation, in dysmenorrhea with a tendency of blood clotting, and in other conditions.

(c) Uterus, Vagina and External Female Organs. These are made into inedible tallow and fertilizer.

(d) Fetus and Fetal Membranes. The uterus is cut open and fetus removed. Skins of fetuses mature enough, are removed and used in leather manufacture. The bodies are tanked for inedible tallow and fertilizer. In some sections of the world, fetuses are used for food, as in "Chinese" dishes, etc. It has been stated that before the inauguration of pure food laws in this country, a common practice was to can fetal meat and put it out under a label as potted chicken.

Fetal membranes may be desiccated for pharmaceutical use. Placenta extracts are used to improve the quality of milk of mothers and in cases of metorrhagia, to check the flow.

(e) Mammae. Udders frequently are diseased and only under exceptional circumstances should they be used for food purposes. When desired for food purposes, udders from cows for breeding purposes only, should be examined by palpation, and incisions made when necessary. Udders from dairy cows should be sliced in sections about 2 inches thick, then thoroughly inspected. This inspection should also include the supra-mammary lymph nodes. Mammary gland substance, made from heifers not over two years old, is sometimes used as a most effective ovarian antagonist in uterine disturbances connected with menstruation.

(f) Penis. The pizzle is inedible and used for glue manufacture. Prostate extracts are said to be used in male disorders.

(g) Testes. "Fries" from young animals may be saved, chilled, frozen and packed. Those from older animals are not desirable for food purposes being too coarse and fibrous. From an Army standpoint they are considered inedible and go into inedible tallow and tankage. An orchic substance has been prepared but therapeutically it has been a serious disappointment.

(h) Kidneys. Kidneys commercially are not removed from carcass beef. They are removed from beef intended for the Army when the commercial trim is not specified, also from "cutting" cattle on the cutting floor when the carcasses are divided into wholesale cuts, from canner cattle and others boned out, and are found in retail markets.

Kidney knobs, i.e., the kidney with adjacent fat covering should be split and inspected thoroughly before they are used for food. Kidneys, enucleated from the suet should be sectioned, soaked and washed, and inspected for pathological conditions, parasites, deteriorations and contaminations. The fat, if not rancid or otherwise objectionable, may be used for tallow or oleo stock. Kidneys are graded out, those from the better grades of carcasses when fresh should be firm, plump, have a reddish brown color, and weigh about $1\frac{3}{4}$ pounds. Kidneys from cutting and canner grades may be pale and thin, lacking the quality, of the better grades and are not desirable for Army use. "Shop" kidneys, if soft, discolored, malodorous, especially having a strong urine odor, should be rejected. Kidneys are sold fresh, frozen, used in sausage, extract, canned products or tanked.

(i) Urinary Bladder. After the veterinary post-mortem examination, urinary bladders of food carcasses are drained to prevent resulting ammonia odors. They should be free from blood and manure stains. All fats are trimmed from the neck which is left as long as possible. The bladders are washed and handled quickly into ice water. They are then inflated, or distended with air from a compressed air jet, ligated with a string around the neck to prevent the escape of air, tied into large bundles, and dried about twelve hours in a room having good air circulation and heated to about 140°F. by means of steam coils. After drying and before grading they are softened by hanging in a moist cooler, or by placing them over steam for several minutes. This prevents subsequent cracking or damaging when measured or folded. Bladders are graded according to the width and not the length.

Grades of Urinary Bladders of Cattle

(Packers' Encyclopedia)

Large Bladders, neck on, to be 12 inches and over in width, 24 pieces to the bundle, tied both ends, and packed 25 bundles or 50 dozen per barrel. Mark "Large Beef Bladders."

Medium Bladders, neck on, to measure from 10 inches to 12 inches in width, 24 pieces to the bundle, tied both ends, and pack 40 bundles or 80 dozen per barrel. Mark "Medium Beef Bladders."

Small Bladders, neck on, to measure from 7 inches to 10 inches in width, 24 pieces to the bundle, tied both ends, and packed 50 bundles or 100 dozen per barrel. Mark "Small Beef Bladders."

Some very large bladders are reduced in size by simultaneous cutting and sewing. They are so cut that a third bladder container may be

made from the remnants of two whole bladders. Only bladders with necks are desirable for sausage purposes. "No Neck Bladders" are graded the same as the others, but packed separately for use by putty manufacturers.

In packing bladders only tight containers as first-class sugar barrels or metal lined boxes, sound in every way, should be used to prevent rat and insect infestation. Packages may also be lined with tar paper, and red pepper sprinkled over the bladder casings in the containers to repel insects. Bladder casing should be stored in a dry, cool place.

(7) Abdominal Viscera. (a) General. The sanitary requirements of the Army Veterinary Meat and Dairy Hygiene Service as discussed in regulations, tend to prevent as far as possible any fecal, pus or floor contaminations of the carcass and viscera. This is important from aesthetic, sanitary and disease transmission standpoints. The contamination of meats from ingesta or fecal matter due to careless or improper methods of butchering or subsequent handling may result in food poisonings due to the colon group of organisms. The oesophagus and rectum should be ligated before evisceration. Before the duodenum is divided it also should be tied in two places adjacent to the abomasum, then severed between the two ties. This separates the stomachs from the remainder of the abdominal viscera.

The viscera of cattle which has passed the veterinary examination is sent or dropped from the killing floor to the offal (gut) room, which in many packing houses is adjacent to or directly under the killing floor. In the gut room the enteron is emptied, cleaned, divided and fats removed and trimmed. This room is supplied with various facilities and equipment as hot and cold running water, tables, chutes, troughs, scalding vat, washers, etc., and is connected with a special manure room. The offal room should be inspected frequently for compliance with all sanitary regulations. It should be free from tank or rendering odors, flies, steam and other objectionable features.

(b) Caul and Stomach Fats. Wherever possible the caul (gastric omentum) and all other stomach fats should be removed from the carcass before evisceration. This will tend to prevent any contamination from the stomachs which would require their rejection. Frequently these fats accompany the viscera to the offal room where they are thoroughly removed and handled as quickly as possible into the oleo department for chilling. They are rendered into edible tallow or oleo stock according to grade and demand. Dirty fats are rendered into inedible tallow.

(c) Spleen. The spleen (melt) which in cattle weighs about 2 pounds is removed from its attachments to the paunch. Commercially when used fresh or for sausage it is washed and hung in the cooler to chill. The demand as a food product is limited and it is usually rendered in the brown grease tank. For Army use it should be considered inedible as it may contain foci of infection without macroscopic lesions. Spleen preparations may be used as a source of iron in the food, but its use to influence the assimilation of iron is of doubtful value.

(d) Oesophagus. The oesophagus or weasand is cut from the rumen, immediately flushed and sent to a special bench. Here the tracheal (gullet) rings and adherent fat are removed, the organ thoroughly washed and the musculature (weasand meat) stripped with a sharp knife from the thin, strong, semi-transparent inner coat or layer, the mucous membrane. Care must be taken not to injure this mucosa by cutting or scoring it during this operation.

After removal, the weasand meat is given a veterinary examination for contaminations, bruises and parasites, the musculature affected being rejected. Especially during November the musculature of the oesophagus is frequently parasitized with the larval form of Hypodermae. These grubs or "worms" are about the size and shape of an oat grain, transparent-white, being imbedded in the musculature. If slightly infested, the parts affected should be removed and rejected; if well marked the entire weasand meat should be rejected. Weasand meat passed for food is used for sausage and canning purposes.

The inner or mucous layer is also called the "weasand." It is thoroughly washed, turned inside out, chilled over night in cold water with ice added, one end tied, inflated with air from a compressed air jet, the other end tied to maintain the distended condition, and then air-dried at about 140°F. in a drying room having good air circulation to avoid the acquirement of an objectionable odor. After being dried over night, the weasands are taken out of the drying room. They are then inspected and graded on a glass-topped table, illuminated underneath by means of an electric light. The light shining through the glass and weasand reveals any defect as blood stains, cuts and parasites (Hypodermae larvae and Gongylonema scutatum). All weasands used as sausage casings must be of first quality, properly handled, dried, clean and absolutely free from blood stains and parasites. Weasands are a high grade casing being by far the best casing on the market. Parasitized weasands may be used by snuff manufacturers.

Grades of Weasands

(*Packers' Encyclopedia*)

No. 1 Weasands are to consist of those which are 24 inches and over in length and $2\frac{3}{4}$ inches and over in width, free of grubs, with a few blood stains permissible. Pack 25 pieces to the bundle, tying ends and center, packing 100 bundles in box or sugar barrel. Mark package "No. 1 Weasands."

No. 2 Weasands are to be 24 inches and over in length, any width, may contain blood stains, grubs and weasands under $2\frac{3}{4}$ inches wide which would otherwise be graded as No. 1. No. 2 Weasands to be packed 50 pieces to the bundle, 60 bundles to box or barrel. Mark package "No. 2 Weasands."

No. 3 Weasands are to be from 18 inches to 24 inches in length, may contain grubs, blood stains and be of any width. Packed 50 pieces to the bundle, 70 bundles to box or barrel. Mark package "No. 3 Weasands."

Packing and storage of weasands are much the same as that for beef bladders. The differentiation of beef weasands from middles is easy. The surface of the weasand casing is glossy, smooth and without any trace of muscle fibers whatever, while in beef middles the circular muscle fibres are very apparent.

(e) Stomachs. *General.* The stomach or paunch of cattle is composed of four distinct compartments, the first three of which are considered as diverticula of the oesophagus, while the fourth is the true or secreting stomach. They are known as follows:

"First stomach, first paunch, paunch or rumen." This is the largest stomach and is the source of plain cattle tripe.

"Second stomach, honey comb paunch or reticulum." This is the smallest stomach from which the best tripe (honey comb) is produced.

"Third stomach, manyplies, peck or omasum."

"Fourth stomach, true stomach, rennet or abomasum."

After the caul and other stomach fats have been removed, the paunch and honeycomb are first separated from the peck and rennet. Then the peck is severed from the rennet. Inspection should be made of these stomachs to insure their freedom from abscesses, large adhesions, hemorrhages, acute inflammations and infections of the gastric-lymph nodes.

Rumen and Reticulum. A blunt hook is inserted into the honeycomb where the peck has been removed. The first two stomachs are then hoisted over a manure chute or receptacle where the paunch is slit open with a knife and the contents expelled. The paunch manure may be thrown away as waste, used as fertilizer or dried, pressed and used as a low grade fuel. The stomachs are now placed on a conical table (umbrella washer), on which a spray stream of water flows constantly.

Here any additional fat is removed, the paunch is then turned inner-side uppermost, washed and scrubbed clean with coarse brushes, removing all paunch ingesta. All dirty pieces are then trimmed off.

Formerly these stomachs were fermented or sweated from twelve to fifteen hours, submerged in water at 60 to 65°F., allowing the easy removal of the mucosa with bell scrapers. As this fermentation represents the early stages of decomposition, this practice is not looked on with favor, so at the present time the following method is, in general, used:

After thorough cleaning as outlined above, these stomachs are placed into a rotary tripe washer. This consists of a large cylinder revolving inside a tank containing an aqueous solution of lime or sal soda (1 pound of sal soda to 10 gallons water) heated from 140 to 150°F. Here the "tripes" (stomachs) are agitated about twenty minutes or until the agitation and alkali have cleansed and freed the inner surface of all mucus and ingested matter and are clean, white and sweet.

It is important that the lime or sal soda does not impair the wholesomeness or quality of the product and is eliminated during further process of manufacture. The regulations provide that cattle paunches intended to be used should be thoroughly washed, immediately after being emptied of their contents. In the preparation of tripe, all fats should be removed as they are more or less dirty. In cleaning tripe, plenty of water should be used, the inner surface being brushed thoroughly. After fermentation or sweating, all foreign material should be removed with scrapers. If sweated too long or not allowed to cool properly, souring may occur. The clothing of all employees in the tripe room should be changed frequently as they become very dirty.

In small abattoirs instead of the rotary washer, the tripes are placed into hot water (140° to 150°F.) several minutes enough to loosen the mucosa. They are then scraped with bell scrapers until thoroughly clean, then washed.

All scurf and mucus must be removed before cooking which is then accomplished in steel or wooden vats using boiling water two to four hours or until cooked soft and tender. Steam must not come into contact with the tripe. It is then chilled several hours (four to fifteen hours are the limits) in water, preferably with ice added. It then passes to the finishing tables where the "finishers" scrape free all remaining fat and foreign matter and trim the edges about one-fourth inch. The tripe is then washed in cold water to remove all loose fat particles, placed into ice water and chilled. It is then inspected,

classed and graded according to kind, quality and cleanliness. The shrinks from the unclean tripe to the finished product average about as follows:

Scraping shrink 11 per cent from unclean weight.
Cooking shrink 39 per cent from scraped weight.
Finishing shrink 26 per cent from cooked weight.
Total shrink 55 to 60 per cent from unclean weight to the finished weight.

Tripe is sold fresh, the honeycomb being more desirable than plain tripe. It is also pickled, canned or placed into sausages and potted meats. If shipped fresh it should be thoroughly iced to prevent spoilage in transit. It may be cured in 50° plain pickle with a small amount of salt-petre added, then packed three weeks in vats or smaller containers in 55° grain white vinegar at a temperature of 40° to 48°F. It is packed for shipment in 45° grain vinegar which may be spiced. Cooked tripe may absorb large quantities of the vinegar. It gains 20 to 35 or even 50 per cent when packed in vinegar, thus requiring repriming of all containers at the final packing before shipment. It is packed in the following sized containers in salt brine or in vinegar:

Kits, 13 to 15 pounds.
Eighth-barrels, 17 to 20 pounds.
Quarter-barrels, 36 to 40 pounds.
Half-barrels, 73 to 80 pounds.
Barrels, 188 to 200 pounds.
Tierces, 290 to 300 pounds.

Tripe is sometimes canned in milk, using a good quality of paper liners. Even this does not always prevent the product from turning black. Large quantities of tripe, including tripe trimmings, are used in sausage manufacture and in potted meats.

Omasum. The third stomach is not used in tripe, but may be slashed or hashed, manure washed out, then rendered into inedible tallow, fertilizer, or is made into poultry food.

Abomasum. The fourth stomach is flushed, cut open from end to end, cleaned and washed, then rendered into inedible tallow, fertilizer or into stock food tankage. The duodenal ends go into inedible tallow or tankage.

(f) Pancreas. The pancreas, an accessory organ of digestion, known as the "belly sweetbread" is sometimes saved, chilled and sold fresh or diverted to the pharmaceutical trade. Pancreatin is used as a digestant. When not saved it accompanies the other abdominal fats to the oleo department.

(g) Intestines. *General.* After the stomachs are separated from the intestines, the latter are placed on a table, preferably a sanitary steel table provided with fluted metal arms.

Small Intestines. There suspended by the outer portion of the mesentery, and hanging over the edge of the table, the small intestines (beef rounds) are detached (run off) with a sharp knife, beginning at the duodenal end. The average length of the small intestines of cattle is 130 feet and about 2 inches in diameter. After the rounds have been freed from their natural attachments and fat, they are flushed with water, stripped to remove any fecal material, washed, then put through a fatting machine (fatted) two times. This machine, equipped with revolving fibre brushes, removes all particles of external fat (machine fat). The rounds then are run into a tank of warm water (80°F.) to wash off all loose fat, then turned inside out by means of a funnel or by hand. Five or more sets of rounds are looped, tied in the center and put through a sliming machine. This machine, equipped with revolving bristle brushes and reels, removes all the slime (mucosa and submucosa) adhering to the inner surface of the intestines. In small establishments the removal of slime is accomplished by means of hand scrapers. The rounds are placed into a container of cool water.

They are next examined to determine their freedom from slime, tallow or other defects. The regulations provide that only such animal casings will be permitted for use as meat containers as are from inspected and passed carcasses. The casings should be carefully inspected to see that they are washed and flushed with clean water, are suitable, clean and free from stains, odors and nodules. Casings showing infestation with Oesophagostomum or other nodule producing parasite should be rejected unless the infestation is slight when the portion affected only need be removed and rejected. The sliming of casings should be done only in compartments separate from all other rooms.

The casings are then inspected for size and quality, each being flooded with a small amount of clean water or mechanically inflated with air in this process. Beef rounds are divided into two classes, export and domestic, depending on the frequency that nodules are present in certain parts also upon certain portions of the casing being stronger than other parts. About 75 per cent of cattle small intestines immediately following the stomach is used as export beef rounds. The remainder known as domestic rounds, frequently are so heavily para-

sitized that it is impracticable to utilize them. As a rule domestic rounds should not be used for Army sausages. Export rounds of good quality are desirable.

Grades of Export Beef Rounds

(*Packers' Encyclopedia*)

Narrow Export Rounds, to measure $1\frac{1}{4}$ inches and under, and packed in glucose tierces 225 or 250 sets per tierce and branded "Narrow Export Rounds."

Regular Export Rounds, to measure $1\frac{1}{4}$ inches to $1\frac{1}{2}$ inches and packed in glucose tierces 200 to 225 sets per tierce, and branded "Regular Export Rounds."

Wide Export Rounds, to measure $1\frac{1}{2}$ inches and over and packed in glucose tierces, 160 to 180 sets per tierce, and branded "Wide Export Rounds."

After grading, rounds are run into a vat of cold water, (45 to 50°F.) to chill one-half to one hour with occasional stirring. In summer. ice is added to the chill water. They are removed, salted with fine, bulk provision salt, packed in bins to drain twenty-four to thirty-six hours, then removed, salt shaken off, resalted, then packed in tierces or glucose barrels containing many holes about 1 inch in diameter. Here they are subjected several hours to pressure to express the excess moisture from the casings and to reduce the bulk. They are now removed, re-salted and packed in regular well coopered water-tight tierces, each tierce is then filled with 100° plain pickle (saturated aqueous salt solution or brine) and headed up water-tight when it is ready for shipment and the casings ready for use. Only clean casing containers should be used. All beef casing packing should be conducted in a cold room. Packing should start within three days and should be completed within a week after production. Casings should be stored on the bilge in a cellar at about 45°F. If stored at a high temperature casings are liable to become slimy. Cured beef rounds are used for sausage casings using about 16 pounds of meat to 1 pound of casings.

Small intestines also may be used for musical instruments and tennis racquet strings, being split between the greater and lesser curvature on 2 sides, then cured, tempered, bleached with hydrogen dioxide, wound into strands, colored if desired, stretched, dried (ten to fifteen days), sand-papered smooth, calibrated and sorted, cut into desired lengths, coiled and then packed.

The ruffle with its contained lymph nodes, after its removal, is sent to the oleo department.

Slime is collected from sliming machines by gravity, with the addition of as small amount of water as possible. If evaporators are

available, slime is first cooked alone or with offal. The solid material is separated for tankage and the liquid material goes into the "stick" evaporator. Slime may be cooked with blood and recovered for fertilizer. Slime contains about 5 to 8 per cent of solids which contain about 15 to 16 per cent ammonia. Scrap guts go into the inedible tank.

Large Intestines. Beef Bungs. After the round guts have been run off, the beef bung is removed. This consists of the cecum (cap-end or blind gut) which averages 30 inches in length and 5 inches in diameter and the first 4 feet of the folded colon, in one part. These bungs are filled with water and stripped, then chilled in cold water one-half hour to solidify the fat which is then closely trimmed off (fatted) with a sharp knife, avoiding scores. They are brushed, using water, to remove any additional fat and stains, turned, slimed by hand with wooden scrapers or by being placed into a washing machine (tripe washer), handled into cold water, then freed from warts or knots (nodules) being trimmed with surgeon's shears. They are next examined for scores, holes, stains, slime or other defects, using water or air in this process. They are graded according to size and quality.

Grades of Beef Bungs

(Packers' Encyclopedia)

No. 1 Beef Bungs, to be full length; that is, $3\frac{1}{2}$ feet or over, and the nipple or round hole must be in center; or in other words, the open end must be as long as the cap end. Must be 3 inches and over in width, prime quality, good color and smell, free of stains and tallow, well slimed, reasonably free of scores, and no holes, although a small hole within 2 inches of nipple hole is allowed. Absolutely free of all warts and pimples. All skins left in bung. Tie in bundles of 5 bungs and pack 80 bundles or 400 pieces to the tierce, branding "No. 1 Beef Bungs."

No. 2 Beef Bungs are bungs measuring 3 inches and under in diameter, prime quality, good color and smell, reasonably free of scores and manure stains, absolutely free of knots or pimples, either naturally or brought to this condition by trimming. Tie in bundles of 5 bungs and pack in 100 bundles or 500 pieces to the tierce, branding "No 2 Beef Bungs."

No. 3 Beef Bungs consist of bungs too heavily infested with warts or pimples. These cannot be used in U. S. Inspected Houses, and should be branded "Domestic Bungs."

After grading they are bulked in salt the same as rounds, removed, salt shaken off, resalted, then packed in tight tierces. Before a beef bung is used as a sausage container, the mucous membrane of the ileocecal valve and the portion of the intestinal wall adjacent should be removed, or the casing so divided and tied that none of the surface covered with mucous membrane actually is used as a container.

When the beef bung is cut too short, or the open end is damaged, cut or badly scored, the cecum if free from nodules and other defects is saved, made into casings called "cap ends" and are packed 750 to the tierce.

Beef Bung Skins. The serosa is frequently removed from the bung gut starting at the cap end and stripping toward the open end. Being very thin it should be removed carefully. It is placed in ice water to facilitate handling, thoroughly salted in the "cap" and outside, drained twenty-four to thirty-six hours, salt shaken from each skin, examined for freedom from fat, stains, holes, ragged edges and other defects, trimmed, if necessary, spread flat on a table and made into bundles of 25, tied in the center and packed in tierces which have been thoroughly washed, paraffined and lined with parchment paper and muslin. In handling, these skins should not come into contact with iron or impure salt as rust or other discoloration will result. These skins are used as gold beaters' skins, and to seal perfume and other bottles. Their removal weakens the bung gut casing somewhat.

Grades of Bung Gut Skins

(*Packers' Encyclopedia*)

No. 1 Bung Skins must be taken off with great care, pulled to the seams on both sides, 30 inches and over in length, free from holes ¼ inch from edge. All fat or tallow trimmed off the edges and holes in edges to be trimmed out. Any skins with rust, manure stains or fatty adhesions are to go in the No. 2 grade. Pack No. 1 skins 25 pieces to the bundle, and pack 3,500 pieces to the tierce.

No. 2 Bung Skins are all skins measuring 18 inches to 30 inches and those having too much tallow, knots, rust and manure stains are to be included in this grade. Pack 25 pieces to the bundle, 4,500 pieces to the tierce.

No. 3 Bung Skins are to include all skins 12 inches to 18 inches in length, packing 25 pieces to the bundle, 5,000 pieces to the tierce.

Beef Middles. These are the remaining portion of the large intestines up to the rectum, averaging 31 feet in length and varying in diameter from 5 inches at the proximal end to 2 inches at the rectal end. They are separated by hand, flushed with warm (not hot) water, and stripped. Middles should be handled in such a manner as will prevent any stains or contaminations. On the fatting bench they are fatted with a knife. Here a spray stream of water washes, chills and conducts the fat (chip fat) to the chill vat. The fat end is cut off about ¾ to 1 foot. They are now handled much the same as beef rounds, except the grading; being run through the fatting machine, loose fat washed off with 85°F. water, manure stains and spots re-

moved, turned, tied in looped sets of about 6 casings, run through a sliming machine three times, inspected for defects, chilled in ice water one-half to one hour, then graded. Middles should be of best quality, good color and odor, ends cut square and free from nodules and holes. They are made into sets of about 62 feet before curing. The maximum number of pieces to a set is 5, the minimum length of a piece, 3 feet 4 inches.

Grades of Middles

(*Packers' Encyclopedia*)

Narrow Middles, to be graded only in localities where there is a demand for this grade. Size $1\frac{3}{8}$ inches and under, and packed 130 sets per tierce, and branded "Select Narrow Beef Middles."

Regular Middles, to contain all middles under 2 inches in diameter, packed 110 sets to the tierce, and branded "Regular Beef Middles."

Wide Middles, to be graded 2 inches to $2\frac{1}{2}$ inches in diameter, packed 90 sets to the tierce, and branded "Wide Beef Middles."

Extra Wide Middles, to contain all middles measuring $2\frac{1}{2}$ inches in diameter and over, packed 80 sets to the tierce, and branded "Extra Wide Beef Middles."

Kosher Middles, to be put up from kosher-killed cattle, same specifications as "regular" middles. Tallow to be left on these. Also have kosher mark or tag placed on middles.

Middles are bulked in salt to drain twenty-four to thirty-six hours, removed, shaken out, and packed in tierces. About 30 pounds of meat can be stuffed into one pound of middle casings. Before use some middles are specially prepared. They may be cut into certain lengths split, gauged, doubled so that the two ends are approximated and then sewed into a casing of increased diameter, using a specially adapted sewing machine for this purpose.

The rectum is about 9 inches in length. After removal, it is fatted and tanked. The anal end is rendered in the inedible tank. The fat tissues of the large intestines if not contaminated go to the oleo department.

(h) Liver. *General.* The liver, an accessory organ of digestion, weighs $6\frac{1}{2}$ to 10 pounds in small cattle and 11 to 13 pounds in large cattle. In younger cattle it is quite thick and plump, in old cows elongated and thin, while, in aged cattle it contains considerable fibrous connective tissue and is not so desirable.

Normally it is reddish-brown in color, but under certain physiological conditions of feeding and during pregnancy it may vary in hue to a light straw color when it is friable and sometimes oily due to fatty

infiltration or some parenchymatous degeneration. During unusual emergency light colored livers of dairy cows or pregnant animals in which disease is not evident or hepatogenous icterus present, and those bearing healed scars, yet wholesome, with no evidence of pathological alteration, may be passed for food purposes. The portal circulation drains the splanchnic area, bringing to the liver many poisons, bacteria and parasites. Some intestinal parasites also migrate into the liver through the biliary ducts while some reach the liver by burrowing through the serosa. Pathological and parasitic conditions are of frequent occurrence, when the liver will vary greatly in color and appearance. Defective or unsound livers are rejected on veterinary post-mortem examination. Livers rejected because of lesions of parasites not transmissible to man, may be used for poultry food after thorough cooking in the establishment.

Gall Bladder. Livers passed for food gravitate to the offal floor. Here the gall bladder is removed carefully to prevent bile contamination of the liver. The gall bladder is slit over a fine meshed screen to collect gall stones; it is then rejected and tanked as inedible.

Gall Stones (choleliths or biliary calculi) of a good yellowish color and unbroken have a high value. They are washed, wrapped in thin cloths away from the light and dried thoroughly in a warm, well ventilated room. If not dried properly they will break easily. They are saved for the Oriental and pharmaceutical trades.

Bile. The bile is saved for the manufacture of desiccated ox gall, biliary salts, or is used by tanners, soap makers and to clean clothes.

Trimming the Liver. Livers are trimmed free from all ligamentous attachments, lymph nodes, fat, pancreatic and other extraneous tissues, and then washed with cold water to remove blood, bile or other external contaminations. Livers should not be soaked in cold water as the grayish color which results detracts from the appearance and the wash water gaining entrance into the liver by means of blood vessels and bile ducts, enhances deterioration. Livers are hung on clean racks, suspended at the portal notch with the thin end down. The thin end is trimmed off or slit to afford adequate drainage. After a veterinary reinspection they are branded with the inspection legend by means of a hot iron. Ink brands are not distinct on dark colored livers.

Preservation and Packing. Livers are placed into a chill room to drain and cool. Clean sawdust should be sprinkled on the floor under the racks to absorb any blood which drains from the livers. Having

very limited keeping qualities, livers intended for early consumption should be handled and shipped under chill temperatures. They may be wrapped in cheese cloth and packed in wooden boxes lined with oiled paper, 25 to 100 pounds net. For periods longer than four days, for shipment, or for export, they should be frozen singly on trays or in a mould, on larger trays holding three or more livers separated by a wooden strip, or en masse in a wooden box. They are more quickly frozen on trays which facilitates their reinspection and grading, also there is not so much danger of improper freezing and spoilage as when frozen in boxes. Livers are sold fresh, frozen and are used in sausages.

Army Requirements. For the Army, beef livers should be from cattle which have passed the veterinary post-mortem examination. Desirable livers weigh not less than 9 pounds when chilled. If possible, they should be from the better grades of steers, strictly fresh, of good quality, short, full, thick, well-shaped, properly trimmed, reddish-brown in color, sound and free from bile stains, contaminations, adhesions or any evidence of trimming for the removal of some defect. Beef livers should be properly handled, chilled and frozen. Reference should be made to current War Department specifications for the purchase of beef livers, which give additional information as to packing, marking, etc.

(8) Thoracic Viscera. (a) General. The pluck, including the lungs, trachea, mediastinum, fats, lymph nodes, heart, pericardium and the thoracic part of the thymus gland, is hung up by the cervical end of the trachea, and separated with a knife into its various parts.

(b) Lungs and Trachea. Cattle lungs, intended for food purposes, should be inspected to determine the presence of foreign matter in the air passages. The main bronchi and branches should be slit and if objectionable foreign matter is present within these passages, the lungs should be rejected. In the case of dairy animals, a minute veterinary examination should also be given the mucosa of the trachea and larger bronchi to determine tubercular lesions.

When not used for edible purposes, the lobes are removed and rendered in the brown grease tank, or they may be utilized for poultry food after first denaturing with an aqueous solution of methyl violet sufficiently to thoroughly color the tissues.

The tracheal fat and lower part of the trachea are removed, washed and sent to the oleo department. The upper part of the trachea goes to the glue house.

The giblet meat (part of the diaphragmatic pillars) attached is saved for sausage. The mediastinum, lymph nodes, fats, pericardium (heart sac) and the thoracic portion of the thymus gland are hashed into cold water. The fats, which float are skimmed and sent to the oleo department, while the residue is tanked. The thoracic portion of the thymus gland (heart sweetbread) may be used in sausage manufacture.

(c) Heart. The heart is trimmed close. The auricles (heart caps or ears) may be saved for sausage, excessive fat removed and saved for the oleo department; and the ossa cordis, heart valves and larger blood vessels removed and tanked as inedible. The heart is washed free from blood clots, blood or other contamination, using clean cold water for this purpose. They are hung by the apex on clean racks or spread on metal trays, given a veterinary inspection, then placed into the cooler to chill. After proper chilling, for local consumption they may be enclosed in cheese cloth or paraffined bags, and packed in barrels or wooden boxes lined with paraffined paper. They may be shipped iced in boxes or barrels provided with an ice tube through the center, filled with crushed ice. Hearts for early consumption should be handled and stored under chill room temperatures as they are subject to deterioration. When transported for long distances they may be sprinkled with 2 per cent of salt or frozen. If they are to be held, they should be frozen quickly. They are sold fresh or frozen, made into sausage, extract or mincemeat, also pickled and canned.

A beef heart weighs about $5\frac{1}{2}$ pounds. The poorest quality of hearts are obtained from canner cows and cutting cattle, some being thin-walled, with little or no surface fat and of decidedly inferior quality. Hearts from pregnant cows are frequently lighter in color and friable. Hearts selected for the Army should be from a good grade of steers which have passed the required veterinary post-mortem inspection. They should be thick, have good color and quality of surface fat, strictly fresh, well trimmed with no ragged edges, clean, in good condition and free from blood clots, excessive fat, adhesions, inedible portions, hemorrhages, blood stains or other contaminations, slime, and objectionable odor. Hearts which have been finaled on post-mortem inspection should not be accepted. The veterinary inspector in selecting for purchase, in addition to the sanitary requirements of the Surgeon General, should be guided by the current War Department specifications for beef hearts.

(9) Miscellaneous. (a) Thymus Gland. This gland known as the "sweetbread" is divided into two parts. The thoracic portion (heart sweetbread) lies in the anterior thoracic space, while the cervical portion extends along the trachea and oesophagus outside the thoracic inlet at the root of the neck. The size of the thymus which undergoes progressive atrophy, is in inverse ratio to the sexual development of the individual. In very young cattle it may weigh $2\frac{1}{2}$ pounds. It is very small in 3 year old cattle, while at 6 years of age it practically has disappeared. However, remnants of the thoracic portion sometimes remain in old cattle. It, therefore, is best when obtained from young animals. Sweetbreads from yearlings are not as good as those from calves. They are removed on the killing floor, trimmed, inspected, placed on trays to chill and sold fresh. They may be frozen to hold or to transport long distances.

Pharmaceutical preparations are made from the thymus gland and used in conditions of young individuals associated with defective nutrition as rickets or oeteo-arthritis.

(b) Thyroid Glands. In adult cattle this gland is pale in color, consists of two lateral lobes, one on each side of the trachea anteriorly near the larynx and connected by an isthmus, a band one-fourth of an inch in width. They are sometimes saved for the pharmaceutical trade, being removed on the killing floor, trimmed and chilled. One pound of glands are recovered out of about 25 cattle. Thyroid glands exert an important bearing on many functions during life. Extracts of the gland are used in cases of hypo- and hyperthyroidism accompanied by cretinism and myxoedema or tachycardia, exophthalmos, enlargement of the thyroid, etc.

(c) Adrenal Bodies. These bodies also known as the suprarenal glands are two in number, flattened and somewhat larger than a lima bean. The right body, pyramidal in form, lies medially against the anterior end of the right kidney. The left adrenal body is about 2 to 3 inches in front of the left kidney on the medial side of the posterior vena cava. Each gland has a medulla and cortex. The medulla may be considered as of ganglionic structure being developed in the embryo from part of the peripheral sympathetic system. These bodies are sometimes saved for the pharmaceutical trade. Two preparations are made, one from the whole gland and one from the medulla. The substance from the whole gland is used in hypoadrenia and sexual infantilism. "Adrenalin" or "Epinephrin" made from the medulla of the gland given hypodermically stimulates contraction of peripheral arterioles,

increasing blood pressure. It is useful in surgical shock as a cardio-vascular stimulant, to blanch operative fields in local anesthesia, as a local hemostatic in checking hemorrhage, also as a diagnostic agent in suspected hyperthyroidism.

(d) Diaphragm and its Pillars. These are known as the "Skirt" and "Hanging tenderloins" or "Hang tenders" respectively. When removed from carcass beef, they should be reinspected carefully for all unsoundnesses including "Spotters" or fibrillar muscular rupture lesions (fatigue hemorrhages), decompositions and other defects. Passed products may be trimmed and put into sausage. A few hanging tenderloins are sold fresh. These are about 1 foot long and 2 pounds in weight.

(e) Tail. Tails from food carcasses are removed on the killing floor, washed, reinspected, branded with the inspection legend, and sent to the cooler where they are chilled on trays. They may be packed in paper lined wooden boxes and sold fresh, or frozen on trays or in shipping boxes, for holding purposes or long transport. When exposed to the air, tails become dried out and dark, otherwise they have about the same keeping qualities as beef cuts. Some tails are cured or pickled, many are used in ox tail soup which is canned.

(f) Cutting bones. These include all bones resulting from boning out cattle carcasses and beef cuts. All bones, except the shank bones may be cooked in open vats, or under reduced pressure in pressure tanks to recover high grade bone oils and edible tallows, the cooking liquors going for beef extract and glue.

The rib bones and vertebrae, together with the head bones may be rendered in open vats to produce No. 1 butter stock used in edible tallow. The leg and pelvic bones are cooked to produce No. 2 butter stock. The bones are placed into a cooking vat and soaked in cold water 1 hour. The water is drawn off and fresh water is used. Steam is turned on until the temperature reaches 120°F., when the second water is drawn off. Then again fresh water is used, steam turned on and the bones cooked (boiled) four-and one-half to seven hours. The steam is shut off, the marrow (fat) skimmed off. Bone oils from the first cooking have a neutral flavor and high color and are used in the manufacture of oleomargarine. The bones may be recooked. The waters may go for extract or glue. The bones are washed about one-half of an hour in either open or closed bone washers, dried, sorted and used in the arts and industries. When cooked in pressure tanks, the residue is dried for fertilizer and "steamed" bone.

Shanks are washed, sawed, parboiled ten to twenty minutes to loosen the marrow which is then blown out of the bone with compressed air and goes to the oleo department for the production of a high grade oleo oil, or is canned for the confectioner's trade.

After removal of the marrow, the bones are cooked in an open vat to recover the remaining oil, then washed and dried.

The average amount of bones obtained from boning out a cattle carcass on one test, follows:

	pounds
Shoulder blade bones	3.16+
Chuck bones	12.0
Forequarter shank bones	13.16+
Hindquarter bones	16.5
Rump and sirloin bones	20.5
Plate and rib bones	25.16+
Total	90.5

GRADES OF THIGH BONES FOR MANUFACTURING PURPOSES
(*Packers' Encyclopedia*)

No. 1, 90 pounds average per 100 pieces.
No. 2, 70 pounds average per 100 pieces.
Culls, under 66 pounds per 100 pieces.

(g) Miscellaneous Fats and Spinal Cord. According to condition and grade these are rendered into edible oleo stock or tallow or into inedible products. (See Chapters XI and XIII).

(h) Offal Test.

BY-PRODUCTS YIELD OF A 1000 POUND STEER
(*Packers' Encyclopedia*)

Trimmed tongue	5.00 pounds
Cheek and head meat	5.00 pounds
Brain	0.90 pound
Gullet	0.25 pound
Lips	1.25 pounds
Heart	3.50 pounds
Liver	10.00 pounds
Kidneys	0.75 pound
Tail	1.25 pounds
Sweetbread	0.30 pound
Suprarenal glands	0.06 pound
Honeycomb tripe	1.50 pounds
Plain tripe	6.50 pounds

Middle casing	32 feet
Round casing	105 feet
Weasand	1 piece
Bladder	1 piece
Bung	1 piece
No. 1 oleo oil	22.00 pounds
No. 2 oleo oil	1.80 pounds
No. 3 oleo oil	0.75 pound
Stearine	13.00 pounds
Prime tallow	4.10 pounds
No. 1 tallow	1.75 pounds
Brown grease	0.16 pound
Hide	65.00 pounds
Switch	1 piece
Sinews and pizzle	2.62 pounds
Dew-claws	0.40 pound
Green blood	35.00 pounds
Dry blood	7.00 pounds
Tankage	10.00 pounds
Hoofs	1.85 pounds
Shin bones	1.60 pounds
Thighs	1.45 pounds
Buttock bones	1.15 pounds
Cannon bone	1.00 pound
Neatsfoot oil	0.85 pound
Grinding bones	13.00 pounds
Horns	0.70 pound
Horn piths	0.90 pound

b. Carcass Beef. (1) General. A carcass beef includes the two dressed sides before chilling (hot), fresh chilled, ripened or fresh frozen. The right side is known as the "closed" side and the left side as the "open" side. The open side is frequently 1 per cent heavier than the closed side. Usually sides are ribbed or quartered in front of the last (13th) rib. A hind quarter without any ribs, weighs 23 per cent of the carcass weight; with one rib, 24 per cent; and with 3 ribs, 26 per cent. A forequarter with 13 ribs, weighs 27 per cent of the carcass weight; with 12 ribs, 26 per cent; and with 10 ribs, 24 per cent.

(2) Classes of Carcass Beef. (a) Mature Beef. *General.* Mature beef includes male and female individuals older and more mature than calves or baby beeves.

Males. These include steers, bulls and stags.

Steers are adult male bovines which were castrated young, before reaching sexual maturity. Usually they are well proportioned, fleshy and plump; having large bones, coarse knees; short, well muscled shanks,

angular pelvic floor, well developed tuberculum pubicum, narrow pelvis, a quantity of pelvic fat, closed inguinal canal, a quantity of scrotal (cod) fat, remains of the crural attachments of the penis (so-called "pizzle eye"), the ischial portion of the gracilis muscle covered with fat and

(Permission United States Bureau of Agricultural Economics)

Fig. 9. Common Bull Carcass

fascia, the exposed portion of the gracilis muscle triangular in shape, a small portion of muscular tissue adjacent and posterior to the exposed pelvic (aitch) bones, sacrum usually not completely ankylosed (usually demarcation lines are apparent); bright, brick-red muscula-

ture, moderately coarse and firm; good development of firm, white or whitish-yellow fat; and a short, medium-thick neck.

Bulls are adult male bovines, sexually mature. Usually, they are massive in structure, with strongly developed muscles which are coarse. In older bulls the muscle tissue is dark copper-red, poor in adipose tissue and dry. In younger bulls the lean meat may approximate that of steers except being coarse fibred. Some bulls show an abundance of both external and internal fat which is white. The neck muscles are exceptionally developed. This crest is sometimes reduced in packing houses while the carcass is yet warm by "dropping the neck," i.e., by severing the funicular portion of the ligamentum nuchae near its insertion. There is an open inguinal canal, a very small amount of scrotal fat, an angularity of the pelvic floor and a strong development of the tuberculum pubicum. The other male characteristics present in the steer are found in the bull, except that in young bulls the ischial portion of the gracilis muscle may not be covered with fat when the exposed gracilis muscle is bean shaped. Age should also be considered with reference to the ankylosis of the sacrum.

Stags are adult male bovines castrated after reaching sexual maturity and in which the inguinal canal has closed and all wounds of castration have healed. The characteristics of flesh and fat are contingent to the age of the animal at castration and other conditions prior to slaughter.

Females include cows, heifers and spayed heifers.

Cows are adult female bovines with their first calf or having had one or more offspring. Usually they have an inferior, angular conformation, prominent hips, large barrel, deeply curved back, slender shanks, small knees, a long, thin, tapering neck; yellowish and irregularly distributed external fats; "gobby" and "wasty" internal fats and white, flinty bones. The vertebrae of the loin region usually are fractured during the splitting operation. The sacrum is yellow and ankylosed; the pelvic floor is only slightly angular to flat; the tuberculum pubicum is not as well developed as in a steer; the pelvis is broad; the external fat tissue of the hind leg approximates the tuber ischii (pin bones) and the exposed gracilis muscle is bean-shaped or crescentric. In place of scrotal (cod) fat, there is present the udder or part of the udder containing developed parenchyma, or a defect in that region where the udder has been removed. It may happen that the fascia of this region is purposely skewered over a piece of fat so placed as to simulate cod fat of the steer.

Heifers are yearling or other female bovine animals which have not given birth to offspring and which are not with calf. A heifer carcass is differentiated from a steer carcass by the presence of an undeveloped udder free from parenchymatous tissue and an absence of male genital characteristics. A heifer carcass differs from a cow carcass in lack of udder development and usually showing less age.

Spayed heifers are female bovine animals which have had the ovaries removed. They can be determined on the killing floor before evisceration and possibly in the chill room by the presence of a surgical scar. However, very few spayed heifers are marketed.

(b) Baby Beef. Overgrown steers and heifers between the veal calf and yearling stages, of quick maturing beef type, well bred, intensively fattened to a prime slaughter condition at eight to fifteen months of age, come under the class termed, "Baby Beef." Usually they weigh 500 to 1000 pounds and dress out from 53 to 60 per cent.

(3) Methods of Grading. (a) General. Carcass beef is graded out according to quantity, quality and soundness. Quantity deals with the carcass as a whole, both as to form and weight, to the thickness or amount of lean meat and to the finish or amount and distribution of fat. Quality concerns the carcass as a whole, including age, and each of its individual components as musculature, fat, cartilage and bone. Soundness is of sanitary significance and is very important in grading. Sex, type, and nutritive value also are grade factors. It is very difficult to grade out either hot or frozen carcass beef.

(b) Quantity. *Form* includes the general conformation of the sides of a carcass and the porportion of the various parts. Sides should be thick, compact, full, well rounded with good width of back; short, full neck and shanks; and heavily fleshed loins, rounds, ribs and chucks. Defects in conformation may exist; as, long, rangy, loosely coupled sides, thin chucks, hollow loins, large shelly plates, prominent hips and poorly developed rounds.

Weight is of minor importance in grading carcass beef except in the higher grades. The heavier beef type of steers, eighteen months to three years of age usually have better form, thickness, finish and quality. Weight may increase with age and is influenced by the sex and type. Lighter weights may be found among younger, aged or dairy individuals. Carcasses are quoted in the following weights in pounds:

500 and under.
500 to 550.
550 to 600.

600 to 650.
650 to 750.
750 to 850.
850 to 950.
950 and over.

Thickness refers to the amount or development of musculature, especially on the better wholesale cuts as the loins, ribs and rounds. These should be well-meated, thick and compact.

Finish refers to the quantity and distribution of adipose tissue. Desirable finish consists of a smooth, well distributed covering of high quality fat over the exterior of the carcass, the greatest depth being along the back, loins, ribs and rump and diminishing toward the neck and shanks. There should be a generous amount of white, brittle, kidney fat; some pelvic (crotch) and suprasternal fats. Festooning of fat is desirable on the inner thoracic wall. The musculature should be well interspersed with fat deposits as is seen in the neck region, at quartering and as a network in the inner flank region. Defects, are a small amount of fat, absence of marbling, uneven distribution of fat, or thick, wasty or gobby deposits.

(c) Quality. *General.* Quality as it relates to carcass beef serves to identify the distinctiveness of character as seen in the carcass as a whole and in its component parts. Quality is influenced by the age and sex of the animal, the conditions surrounding it before slaughter including feed; methods of slaughter, bleeding, dressing, handling, chilling, sanitary conditions of compartments involved, and length of time intervening since slaughter. Quality is also influenced by the conformation, thickness, finish, and soundness.

Carcass. Carcass beef of the best quality has excellent conformation, depth, and finish. Irregular conformation and shallowness of depth are indications of low quality. Sex is also considered a factor in judging quality.

Age. The highest quality of mature beef is found in bovines eighteen months to three years of age. Animals under eighteen months are not mature enough, while in cattle older than three years the flesh is coarser, fibrous, dark colored; and of lower quality.

At two years of age the cartilage in the sternum and the "buttons" which tip the dorsal spines (chine bones) of the thoracic vertebrae, are pearly white and soft, while the bones are soft and red. In steers small red puncta begin to appear in the buttons at two years. At three years the cartilage is grayish and red areas are more numerous.

Ossification of the buttons progresses until at six years of age the ossified buttons have united with the bone. The red bone marrow of the vertebrae is gradually replaced by yellow bone marrow, and the bones become harder and whiter as age increases. These changes take place more quickly in cows. After three years no buttons are present and the vertebrae of the back crush, splinter and break when split with a cleaver.

If necessary, age of a cattle or lot of cattle can be determined approximately by examination of the permanent incisor teeth at time of slaughter. At two years of age the first incisor teeth are fully developed; at three years, the second incisors; at four years, the third incisors; and at five years, the fourth incisors.

Musculature. The lean meat is judged according to color, firmness, dryness, fineness of texture and tenderness. High quality would require a bright, light, cherry red; finely grained, relatively dry, firm, velvety flesh. Defects are dark, tough, watery or soft flesh.

Fat. Fats are judged by their amount, distribution, firmness, color and amount of marbling. External fat should be evenly distributed, smooth, and firm. Internal fats should be generous in amount, creamy white, firm and crumbly. Defects are soft, yellow, gobby fat; uneven distribution and scarcity of fat.

Cartilage and Bone. Bones should be relatively fine, soft and red with presence of sufficient cartilage to assure an animal eighteen months to three years of age (See "Age"). Defects are coarse, white or gray, hard bones and lack of cartilage.

(d) Soundness. Carcasses which have not passed satisfactory, recognized, veterinary ante-mortem and post-mortem examinations in accordance with Army Regulations; those not bearing the official "Passed" inspection legend of an authorized inspection agency; or which have not been properly stored or handled subsequent to post-mortem examination, and those bruised, imperfectly bled, affected with joint sourness, grubs, other parasites or fractures, or which are slimy, tainted, deteriorated, overripe, mouldy, decomposed, insanitary, unclean, unwholesome, unfit for human consumption or otherwise unsound, have a "No Grade" status. "Spotters," i.e., carcasses showing fibrillar muscular rupture or "fatigue hemorrhages," are considered unsound. Bruises of the hip region may be more extensive than a casual visual examination may disclose.

(4) Grades. (a) General. Under any of the sex classes, mature carcass beef may be divided according to the grade factors under

"Methods of Grading" into grades as No. 1-A or Prime, No. 1 or Choice, No. 2 or Good, No. 3 or Medium, No. 4 or Common, No. 5 or Cutter, No. 6 Canner and "No Grade." Intermediate sub-grades are frequently made for the major grades, as "top," "medium" and "low."

In the higher grades finish is essential and weight, soundness, thickness, quality and finish are of importance. In the medium and lower grades, thickness and form are important, finish of minor importance and quality, weight and soundness are of lesser value.

Of steer carcasses found on the market, about ½ per cent grade as prime, 4 per cent choice, 22 per cent good, 53 per cent medium, 17 per cent common and 3½ per cent cutter and canner.

The grades for "Baby Beef" are No. 1-A or Prime, No. 1 or Choice, No. 2 or Good; No. 3 or Medium, No. 4 or Common and "No Grade." Older individuals may be graded out under mature beef grades, while very young individuals may be graded out under veal grades. Very little distinction is made between steer and heifer carcasses. Prime baby beef carcasses dress out about 60 per cent, Choice 58 per cent, Good 56 per cent, Medium 54 per cent and Common 53 per cent.

(b) Mature Beef. *General Grades.*

No. 1-A or Prime Carcass Beef is restricted to steers and heifers of the best beef type from eighteen months to three years of age, perfect in regard to form, thickness, finish, quality and soundness; showing the result of proper intensive fattening and weighing 500 to 700 or more pounds. They dress out about 60 per cent of the live weight.

No. 1 or Choice Carcass Beef is restricted to steers, some heifers and a few young cows. Carcasses under this grade closely resemble those of the prime grade with the exception of slight deficiencies in finish either as to amount or distribution. Choice cows dress out about 54 per cent, and choice steers and heifers 58 per cent.

No. 2 or Good Carcass Beef includes steer, heifer, cow, bull and stag carcasses showing some evidence of intensive fattening, or a few superior individuals fattened on grass. They are above the average in form, thickness, finish, and quality. They should show some marbling with absence of blue on the loins, rounds and shoulders. They frequently lack the finish that choice carcasses possess and sometimes are too fat and wasty. Good cows dress out about 52 per cent, good steers and heifers 56 per cent; and good bulls and stags 60 per cent.

No. 3 or Medium Carcass Beef includes all classes of carcasses. They are only average as to form, thickness, finish and quality. A carcass

may be slightly angular or loose in conformation, and the bones somewhat prominent, coarse and hard. The fat may be fairly well distributed but not plentiful except in some old cows. The rounds frequently are only moderately well covered. About one-half of all carcass beef is found in this grade. Medium cows dress out about 50 per cent; medium steers and heifers 54 per cent; and medium bulls and stags 58 per cent.

No. 4 or Common Carcass Beef includes old dairy cows, scrubs, poorly fed range cattle, bulls and stags, quite deficient in form, thickness, finish and quality. They have an angular appearance, prominent hip bones and a lack of depth to the flesh. Large blue areas are present due to lack of finish. Fats usually are yellowish and poor in quality. Frequently the bones are white, hard and flintlike, with a general absence of cartilage, denoting advanced age. Common cows dress out about 48 per cent; common steers and heifers 52 per cent; and common bulls and stags 56 per cent.

No. 5 or Cutter Carcass Beef includes principally cows and is more deficient than common carcasses. Usually only certain cuts as the loins and ribs have sufficient thickness to be sold as wholesale cuts, the remainder of the carcass being boned out for further manufacture into prepared meat products. Cutter cows dress out about 46 per cent and cutter steers 48 per cent.

No. 6 or Canner Carcass Beef includes carcasses from old dairy cows in poor condition and others so thin as to approximate emaciation, anemia, debility and dyscrasias. They are boned out and the meat used principally in the manufacture of prepared products. Canner cows dress out about 44 per cent and canner steers 46 per cent (See Fig. 17.)

"No Grade" Carcass Beef. (See "Soundness.")

Steer Carcasses.

(*No. 1-A or Prime Steer Carcasses* (*Bureau of Agricultural Economics*):

No. 1-A or prime steer carcass has ideal conformation. The outlines are especially attractive and suggestive of abundance of high-grade palatable flesh. The carcass is relatively short, blocky, and heavily and uniformly fleshed throughout. The rounds, loins and ribs are exceptionally well-developed and rounded. The chucks and plates are very thick and compact and are heavily fleshed. The neck is short and plump. The shanks are short and well-muscled. The superior development of the round extends well over, almost enveloping, the hind shank, increasing very much beyond the average amount of flesh at that point. Soft,

pearly white cartilages are found on the spinal processes of the chine bones and on the breast bones. The bones are soft and red with blood vessels, and the carcass has every other evidence that the animal had not far exceeded the third year. The finish is ideal, being neither excessive nor deficient. The exterior surface of the carcass, including shanks and neck, is entirely covered with a smooth, brittle, slightly creamy, white fat that is not excessively thick or wasty at any point, the greatest depth being over the loins and ribs, not exceeding three-fourths of an inch. The interior walls are equally well covered. The cod, kidney, crotch and other interior fats are abundant but not excessively wasty, and are firm, crumbly and of pinkish or creamy-white color. An excessive, or slightly deficient, amount of fat will bar a carcass of prime quality from this grade (See Fig. 2.)

No. 1 or Choice Steer Carcasses (Bureau of Agricultural Economics):

A No. 1 or Choice steer carcass does not differ radically from a prime steer carcass. It is of excellent quality conformation, thickness of flesh, and finish, but does not fulfill all the requirements in the specifications of the prime grade. The greatest variations generally are in the quality and finish but in no case are these pronounced. The fat covering is smooth or slightly wavy. The cod, crotch, kidney and other interior fats may be slightly deficient or more abundant than required in the ideal carcass. Often they are more abundant and wasty but are always of the best quality, and similar in color and consistency to those in prime carcasses. The cartilages on the chine and breast bone are pearly white, but may be slightly ossified and the bones may be soft and red or slightly hardened and of grayish white color, especially if the animal was nearing the fourth year when slaughtered. The marbling is always present in the loins, ribs and chucks, and the flesh is firm, velvety and of an attractive light or cherry red color. All carcasses surpassing the specifications for the good grade but failing to qualify as prime belong in this grade. While No. 1 or choice carcasses may appear on the market at any time during the year, they are never abundant but are more in evidence in the winter and early spring. The weights are similar to those of prime grade (See Fig. 3.)

No. 2 or Good Steer Carcass (Bureau of Agricultural Economics):

A No. 2 or good steer carcass has good conformation, thickness of flesh, finish and quality. In these respects it is above the average, but does not qualify for the choice grade. The carcass generally does not have the blocky, well-rounded form of those in the superior grades but is more angular. The hip and shoulder joints are slightly visible, the loins and ribs are moderately round and plump but inclined to flatness. The rounds, while reasonably thick and heavy, are not full towards the shank. The shanks are inclined to be long and tapering but not to a marked degree. The fat covering extends well over the exterior surfaces but generally is firm and at times slightly wasty, especially over the loin, rib and neck. The lower part of the rounds, shoulders, necks and shanks generally have little or no fat covering. The cod, kidney, crotch and other interior fats are in moderate supply and sometimes wasty but generally do not extend completely over the walls of the forequarter as in the better grades. The

fats are of good quality, but often are soft and may have a slight yellowish tinge. The cartilages on the chine and breast bones, usually have lost their pearly lustre and have become partly ossified and firmly attached to the bones which in such cases are somewhat hard and gray. This does not apply, however, to carcasses of animals slaughtered under three years of age. The eye of the rib and loin is above the average in thickness and shows some marbling but the good grade is the lowest in which this condition appears. The flesh generally is of good color but may be a shade darker than that of choice or prime and often is somewhat soft and slightly inclined to be watery. This grade is on the market in moderate quantities throughout the year but is more abundant in the late fall, winter and spring months. Very few good carcasses except from genuine baby beef average as low as 350 pounds. The range is from this weight upward (See Fig. 4.)

No. 3 or Medium Steer Carcass (*Bureau of Agricultural Economics*):

A No. 3 or medium steer carcass has irregular or rugged conformation. This is apparent in the general outline of the carcass which shows a deeper curvature of the back; rough and proportionately large chucks and plates; long shanks; prominent hips and shoulder joints; flat or depressed loins and ribs; long necks; relatively long, flat and tapering rounds; and prominent bones. The flesh in all parts is of average thickness and the grade reflects the average quality of carcass beef on the market throughout the year. The broad sinew along the back is often visible through the fat covering which is moderately thick over the back but very thin or entirely absent over a large part of the rounds, chucks, neck and shanks. There is a small amount of cod, kidney and crotch fat. The other interior fats are present but are very thin. They do not cover the inner walls of the forequarter but are more in evidence in the hindquarter. They generally are of yellowish-white color, soft and of average quality. Usually the cartilages are hard and white and the bones are grayish or white and flinty. This does not apply to carcasses of animals under four years old, a liberal percentage of which are in the medium grade. The "eye" of the loin and rib which varies according to the flesh, condition and size of the animal, lacks the depth in the better grades but these cuts generally are sufficiently thick to satisfy the average popular demand for steaks and roasts. The flesh usually is coarse, "stringy," soft and watery and inclined to a slightly dark red color. It has no marbling but has sufficient finish and quality to satisfy the average consumer. The weights range from 350 to 750 pounds, according to the type and age of the animal. (See Fig. 6.)

No. 4 or Common Steer Carcass (*Bureau of Agricultural Economics*):

A No. 4 or common steer carcass is decidedly deficient in quality, conformation, thickness of flesh, and finish. It is the lowest grade of steer appearing regularly on the market. The outlines are irregular or angular and rangy. The hip and shoulder joints are prominent and the chucks and plates are wide and thin. The loins and ribs are flat or sunken. The broad ligament along the back is plainly visible. The rounds, neck and shanks are long and thinly fleshed. The bones are prominent and generally white and flinty and the cartilages usually are completely ossified. Such carcasses have very little outside fat covering, and such as they have is confined almost exclusively to the thin covering over

the loins and ribs and is of yellowish-white color. The cod, crotch, kidney and interior walls have very little if any fat and this is of very poor quality. The "eye" of the rib and loin is greatly lacking in depth of flesh and this is indicative of the quantity or depth of flesh throughout the carcass. The flesh is decidedly coarse, soft, "stringy," tough and watery and of dark red cast. This grade is found on the market at all times, although in limited quantities during late winter and early spring. The weight ranges from 300 to 550 pounds. (See Fig. 7.)

"No Grade" Steer Carcass. (See "Soundness.")

Heifer Carcasses are graded as No. 1-A or Prime, No. 1 or Choice, No. 2 or Good, No. 3 or Medium, No. 4 or Common, and "No Grade." There are no No. 5 or No. 6 carcasses in the heifer class.

Cow Carcasses are graded as No. 1 or Choice, No. 2 or Good, No. 3 or Medium, No. 4 or Common, No. 5 or Cutter, No. 6 or Canner, and "No Grade." There are no No. 1-A carcasses in the cow class.

Bull Carcasses are graded as No. 1 or Choice, No. 2 or Good, No. 3 or Medium, No. 4 or Common and "No Grade." Bologna bulls are those of the No. 3 and No. 4 grades. (See Fig. 9.)

Stag Carcasses are graded out as No. 1 or Choice, No. 2 or Good, No. 3 or Medium, No. 4 or Common and "No Grade."

(c) Baby Beef.

No. 1-A or Prime Baby Beef (Bureau of Agricultural Economics):

Carcasses of this grade are excellent in conformation and uniformly proportioned. The shanks are short and thick. The rounds are thick and plump and have an outward curve from the rump to the shank. The loins are full or bulging. The ribs and chucks are thick, short and full. The necks are short and plump. The hip and shoulder joints are submerged in flesh and are difficult to locate except by touch. All parts of the carcass are covered with smooth white fat of excellent quality, with greatest depth over loins and ribs. The interior fats are plentiful but not excessive. There is an abundance of marbling through all the thicker cuts except in the rounds and fore part of the chuck. In a word, prime baby beef is ideal beef in all respects.

No. 1 or Choice Baby Beef (Bureau of Agricultural Economics):

Carcasses of No. 1 choice baby beef resemble very closely those of the prime grade in practically all respects. The conformation is usually not quite so good. The greatest difference is in the fat covering, which is not so smooth or evenly distributed. There may be also a slight deficiency of both exterior and interior fats or there may be an excess on some parts of the carcass. In quality and degree of brittleness, the fat compares favorably with the prime grade. While there is slight or no difference in the grain or color of the flesh, there may be a slight deficiency in the amount of marbling. Except in texture of the flesh, choice baby beef resembles the choice grade of carcasses from more mature cattle.

No. 2 or Good Baby Beef (Bureau of Agricultural Economics):

Baby Beef of the No. 2 or good grade differs from the No. 1 or choice grade only in conformation and distribution of fat. The color and grain of the flesh is practically the same. The conformation is slightly less regular and the distribution of fat even less. There usually is less interior fat, but the quality is about the same, being white and brittle or it may possess some of the characteristics of veal fat especially in carcasses from younger beef animals. The flesh is firm, fine grained and light red in color with only slight traces of fat between the muscles.

No. 3 or Medium Baby Beef (Bureau of Agricultural Economics):

No. 3 or medium grade baby beef carcasses appear somewhat angular in conformation, because of a smaller amount of flesh over all parts. The rounds are tapering, the loins and ribs are flat and lack the fullness of the better grades. There is usually a fair covering of fat over the back and practically none on the rounds, shoulders, plates, necks and shanks. Interior fats also are relatively scarce, but usually moderate amounts are found in the hindquarter over the kidneys and in the crotch. The meat is less firm than in the better grades and frequently has a watery appearance. The color varies to some extent, being usually darker than that in the better grades.

No. 4 or Common Baby Beef (Bureau of Agricultural Economics):

The No. 4 or Common baby beef grade is very scarce and often is referred to as split veal. It is irregular in conformation and is lacking in depth of flesh and covering due principally to insufficient or improper feeding. Carcasses of this grade appear more like veal, having practically no covering of fat over the exterior surfaces and very little over the kidneys and in the crotch and scarcely any on other interior surfaces. The flesh is of very poor quality compared with that of the better grades, varying from a pale to a slightly dark red, and is inclined to be watery, but it has a grain and consistency similar to that of large or split veal although it is somewhat tougher.

"No Grade" Baby Beef. (See "Soundness.")

(5) Army Requirements for Carcass Beef. (a) General. These include the sanitary requirements of the Surgeon General; and, if purchased under the Quartermaster General, such purchase requirements as may be specified. The sanitary requirements are outlined in Army Regulations. Also see "Soundness" above, and sections 6, "Storage;" 7, "Shipment," and 8, "Veterinary Examinations." The purchase requirements of the procurement authorities should be carefully studied as well as the commercial grading of carcass beef and commercial practices. The selection of carcass beef wherever performed, at the packing house, in a branch house or at destination

should be carefully done. Carcasses should conform to specifications as to purchase conditions, number, class, quality, condition, grade, weight, trimming, cutting, boning or other preparation, chilling, freezing, wrapping, marking, packing, handling, storage, shipment and reinspection.

(b) Procurement Inspection at Origin. *Selection. General Routine.* In the selection of chilled carcass beef for the Army, the veterinarian should note the marks of prior official inspection, the conditions of its prior handling, shipment and storage; the sanitary conditions obtaining in storage; the length of time which has elapsed since slaughter; and the present condition of the carcass as to sanitation and soundness. If possible, a cooler selection should be made, first making a survey of all available carcasses and conducting an inspection on such lots as are best suited and which come within the desired class. Next, carcasses are graded out according to weight, form, thickness, finish, quality, including age, and soundness; selection being made only of such carcasses as meet the most critical requirements of the Surgeon General and if purchased under the Quartermaster General, the purchase requirements. The carcasses are then branded, prepared, weighed, wrapped, packed or otherwise handled according to requirements.

Selection of carcass beef for canning, curing or other preparation is discussed under "Beef Trimmings."

Recently Slaughtered Animals. For carcass beef, usually only recently slaughtered and properly chilled carcasses are selected, as such beef may be frozen; or stored, handled and transported under varying conditions and temperatures for different periods of time before final issue to troops. If possible, it is desirable to select carcasses within at most, four days of slaughter.

Chilling. Carcasses should be properly chilled. When "hot" beef is crowded in the fore cooler, "blistering" may result, the areas in contact remaining soft, bleached and unsightly. Sourness frequently results in heavy cattle, especially around the femur and in the hip joint region, accompanied with an objectionable odor. Beef intended for the freezer and for export should be examined carefully for this condition which can be detected by means of a meat trier or by cutting into the hip joint with a knife. When hot beef is run into a room of thoroughly chilled carcasses, moisture condenses on the latter and slimy condition, may result.

Sanitary Examination. Examinations for slimy conditions should be conducted, especially on the peritoneal and pleural surfaces, inside

the flank and under the "skirt." Decomposition may early take place in the diaphragm and its pillars. See "Soundness."

Overripened carcasses or those showing "cooler age" as slime, mould or surface discoloration, are undesirable because of above factors and of the loss attending the necessary trimming. Carcasses should be free from fecal, blood, dirt or other contaminations. When pelvic fats are contaminated with feces, they should be trimmed well before acceptance.

Sides which are bruised, or where bruises have been trimmed out, are not desirable. Hip bruises are sometimes more extensive than a surface examination would indicate and may extend along the pelvic bones and into the loin region. Examination should be given the neck muscles, diaphragm and its pillars and the "eye" of beef after ribbing, for fibrillar muscular rupture, or "Spotters" which should be rejected.

Finaled Carcasses. Carcasses finaled for any diseased or parasitic condition as tuberculosis, actinomycosis, large adhesions of the serosa and beef measles, are undesirable. Usually there is a sufficient number of non-diseased cattle from which to select, and mutilations resulting from the final inspections do not improve the keeping qualities of the meat.

Quantity. Selected carcasses should have a good, well balanced conformation with a good development of loin, round and back and a good development of fat indicating grain feed and a well nourished condition. Fats should be firm, well distributed, liberal but not excessive, with a moderate amount of marbling. Regarding weights the veterinarian should be guided by the purchase requirements, if any. The desirable weights are from 450 to 700 pounds. During the World's War, compared to good steer carcasses weighing 500 pounds and under, carcasses weighing 500 to 600 pounds were quoted on one contract, one cent more per pound; carcasses weighing 600 to 700 pounds were quoted $1\frac{3}{4}$ cents more per pound; 700 to 850 pounds were quoted $2\frac{1}{2}$ cents more per pound; while choice carcasses were quoted $5\frac{1}{2}$ cents more per pound.

As a rule an equal number of fore and hindquarters are desired and the difference between them should not exceed 25 pounds in the same carcass.

Quality. In examining carcass beef for quality and thickness, each side should be ribbed, exposing the "eye" of the beef. Carcasses should show good quality indicative of proper feeding. The flesh

should be bright red and have a smooth, fine grain. Dark, coarse grained meat is usually tough. Some marbling is also desirable. The outer covering of fat should be firm, white, and extending well down toward the shanks and neck. Blue loins and large blue areas on rounds are not desirable. There should be some festooning of fat on the inner thoracic wall, a lace work of fat on the inner part of the flank, a brittle white kidney fat and some pelvic fat. (See "Good Grade, Beef Carcasses.") There should not be a preponderance of "staggy" characteristics, hard bones or lack of cartilage. Desirable quality would require individuals eighteen months to three years of age. Carcasses carrying too much fat are wasty and uneconomical. Poor, thin carcasses or those lacking finish are undesirable as the flesh is not so nutritious or palatable but is tough and dry and the percentage of bone is greater than in a good grade of carcass.

Branding. Carcasses, selected should be branded or stamped by the veterinarian in accordance with both the sanitary regulations and the purchase requirements. In the event a stamped carcass is later rejected, these stamps should be removed with a knife. When rejected, the number of carcasses, weight and cause of rejection should be recorded.

Trimming. In commercially trimmed carcasses there are certain attached tissues of low value, not economical to use in Army messes and some of which are prone to rapid deterioration. This includes the heart fat, suprasternal fat, fleshy portion of the diaphragm and its pillars, kidneys and kidney fat, excessive pelvic and cod fat, hind and fore shanks, bloody end of the neck and tag ends of tissues. In very young cattle the sweetbread is removed, otherwise it remains attached to the carcass. For the better domestic trade and for export the pillars of the diaphragm are removed.

To reduce the weight and volume of carcass beef, certain trims sometimes may be required by the purchasing authorities. The trim applied to accepted beef will vary greatly. For emergency purposes, the usual commercial trim and covering are accepted, the inspecting veterinarian recording data pertaining to the class of carcasses, grade, soundness, quality, trim, covering, number of fore and hindquarters and weight. When a commercial trim is specified, the veterinarian should insist on the removal of all loose, fragmentary, inedible and bloody tissues.

When a certain trim is specified and such is not furnished, but carcasses are supplied from stock, a sufficient number of quarters should

be stripped of all coverings, inspected, and trimmed according to specifications and an average deduction made to apply to the entire lot. In an emergency, if this method is likely to delay loading, an agreement is sometimes reached through the purchasing officer and packer's representative as to deductions to be made. A full statement of conditions, however, should accompany the veterinarian's certificate and be shown on his inspection reports to the Surgeon General.

The thymus gland, diaphragm and its pillars; pelvic, heart and suprasternal fats, bloody and tag end tissues are easily removed. The removal of shanks, necks and kidney knobs, however, is not easily accomplished but entails special efforts on the contractor's part.

When the fore shank is required to be removed 2 inches above the anatomical knee (radio-carpal) joint, the cut is made perpendicular to the shaft of the radius, about 4 inches above the commercial cut, at the point where the extensor carpi radialis muscle merges into its tendon. The portion removed from a forequarter weighs about $1\frac{1}{2}$ to 2 pounds and represents about 0.3 per cent of the carcass weight. For freezer stuff the shank sometimes is required to be removed flush with, and parallel to the brisket, the cut passing through the humero-radial joint removing about $\frac{3}{4}$ of an inch of the articular surface of the humerus.

When hindquarters are furnished with the commercial cut (cut off at the hock joint), a deduction of $3\frac{1}{2}$ pounds sometimes is made. This represents about 0.53 per cent of the carcass weight. For freezer stuff the hind shank may be removed midway between the stifle and hock joints leaving the tendon Achilles attached to the quarter for the purpose of hanging. The tuber calcis is sawed through as near the insertion of the Achilles tendons as practicable, sufficient bone remaining to form a substantial attachment for these tendons. The shank bone is sawed through from the anterior face, perpendicular to the shank, at a point in line with the union of the Achilles tendons with the gastrocnemi muscles. A deduction of one pound usually is made for the tendons (gambrel cord) which remain.

The neck sometimes is trimmed perpendicular to the line of vertebrae leaving 3 cervical vertebrae on the carcass. The point of trim may be determined by counting forward from the first dorsal vertebrae with which the first rib articulates. The portion removed from a quarter represents about 1.8 per cent of the carcass weight.

When kidneys and kidney fats are removed, $\frac{1}{2}$ to $\frac{3}{4}$ of an inch of fat should remain as a covering for the underlying tissues including

the tenderloin, which if denuded and exposed to the air may result in loss of moisture and deterioration. A kidney knob so trimmed from a hindquarter represents about 1 per cent of the carcass weight.

The pillars of the diaphragm (hanging tenders) represent about 0.2 per cent of the carcass weight. The fleshy portion of the diaphragm is sometimes removed down to within ½ of an inch of its attachments. The portion removed from a forequarter represents about 0.16 per cent of the carcass weight.

Excessive pelvic fat refers to any which may project beyond the medial plane of a side, as beyond the aitch bone and sacrum.

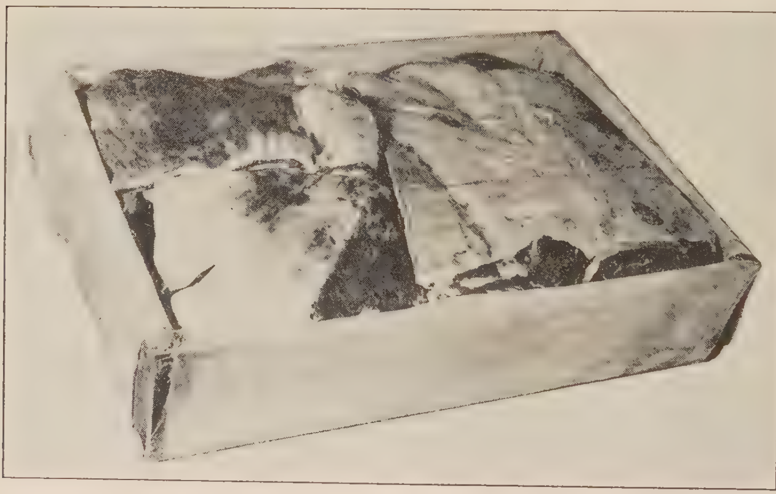

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FIG. 10. FRESH FROZEN BONELESS BEEF

For frozen, boneless beef, commercially trimmed carcasses are selected. The skirts, hanging tenderloins and kidneys; the kidney, lumbar, pelvic, cod, heart and suprasternal fats; and all bloody tissues, are removed. The sides are then ribbed with 2 ribs on each hindquarter. The quarters are then divided into commercial cuts which are boned out. The forequarters are divided into a 3 ribbed-chuck with sinew out; a "Rib" eight ribs wide, boned and with rib fingers attached; the blade is boned out, clod pulled, brisket boned, navel end cut into two pieces and the shank meat and trimmings are included. The hindquarters are divided into the insides, outsides,

boneless knuckle, loin strip, sirloin butt, rump, tenderloin, shank meat, flank (excessive fat removed) and trimmings.

Hind shanks representing 2.82 per cent of the carcass weight may be divided into shank meat, 42.86 per cent and shank bones, 57.14 per cent.

Rounds with rump and shank (R. & S.) off, 17.34 per cent of the carcass weight, may be divided into knuckles 22.09 per cent, insides 33.72 per cent, outsides 26.74 per cent, trimmings 9.3 per cent and bones 8.15 per cent.

Rumps, 3.83 per cent of the carcass weight, may be divided into trimmings 10.53 per cent, fat 10.53 per cent, boneless rump 52 per cent and bones 26.94 per cent.

Loins, 15.42 per cent of the carcass weight, may be divided into a boneless strip 25.53 per cent, tenderloins 16.34 per cent, boneless sirloin butts 20.91 per cent, trimmings 13.07 per cent, fat 7.84 per cent and bones 18.31 per cent.

Flanks, 5.24 per cent of the carcass weight, may be divided into flank steaks 7.69 per cent, lean flanks 46.15 per cent, fat 15.38 per cent and other tissues 30.78 per cent.

Navels, 8.47 per cent of the carcass weight, may be divided into boneless navels 76.19 per cent, fat 4.75 per cent, bones 14.29 per cent and other tissues 4.76 per cent.

Briskets, 6.85 per cent of the carcass weight, may be divided into boneless briskets 41.18 per cent, trimmings 11.76 per cent, fat 17.65 per cent, bones 20.59 per cent and other tissues 8.82 per cent.

Ribs, 9.07 per cent of the carcass weight, may be divided into boneless ribs, 75.56 per cent and bones 24.44 per cent.

Chucks, 20.97 per cent of the carcass weight may be divided into boneless chucks 65.38 per cent, large clods 19.23 per cent and bones 15.38 per cent.

Double, front shanks, 5.64 per cent of the carcass weight, may be divided into shank meat 57.14 per cent and bones 42.86 per cent.

Necks, 0.51 per cent of the carcass weight, may be divided into neck meat 57.14 per cent and bones 42.86 per cent.

Kidney knobs, 2.02 per cent of the carcass weight, may be divided into kidneys 20 per cent and fat 80 per cent.

Small clods equal about 1.01 per cent of the carcass weight and hanging tenders 0.81 per cent.

Bones and other undesirable parts also are excluded from carcass beef boned out for prepared products.

Wrapping. Quarters of beef for domestic shipment usually are transported without any covering. For fancy domestic trade and for export, quarters may be enclosed in stockinette or muslin bags. Freezer stuff may be covered with an inner bag of cheese cloth or muslin and this enclosed with burlap, securely sewed. For local deliveries or when specified, quarters may not be wrapped, but all containers or carriers should be clean and sanitary and the beef protected if necessary by tarpaulins or by other means. Car shipments of chilled quarters sometimes are covered with wrappings to protect the beef from contamination in rehandling and transportation. Coverings as stockinette and cheesecloth, as sanitary protectants are inadequate. Quarters sometimes are covered with unsized muslin, securely sewed. Sometimes an inner covering of cheesecloth or stockinette with an outer wrapping of burlap, securely sewed, is specified. Closely woven cotton sheeting about 4 yards to the pound, with an outside covering of good burlap, is desirable where a covering is used. The cotton sheeting may exclude dirt and contamination from the burlap, while the burlap will take up the wear and tear. The inner covering should be securely tied and the outer one sewed. Fore and hindquarter bags of these materials of various sizes are made to facilitate this operation. Beef for the freezer should have a double wrapping. Should burlap be used next to the quarter, the latter may become tainted from the burlap. In defrosting beef, doubly wrapped, the burlap covering should be removed for the same reason. Markings with lampblack on thin coverings frequently results in contamination of the meat. Outer burlap coverings may be marked quite safely with lampblack paint.

Boneless beef is frozen in moulds or forms holding about 100 pounds net each. The boneless meat from each quarter is packed separately, wrapped in muslin or stockinette. Trimmings are used to fill in spaces between the cuts and to make up weight. The meat so packed is frozen solid, removed from the mould and additionally wrapped with a good quality of gray butcher fiber paper, then enclosed in a paraffined muslin bag and the whole covered with a good quality burlap bag, securely sewed with strong cord forming ears 4 inches long at each of the 4 corners. (See Fig. 10.)

Weighing. Fresh beef from the hot weight to chilled weight will shrink $1\frac{1}{2}$ per cent or more. Only thoroughly chilled carcasses should be selected. After trimming, each quarter of Army beef is weighed separately. It is customary to conduct this weighing after all wrapping has been accomplished, tests being made to determine the exact

tare which is deducted. An unwrapped quarter or one covered with stockinette, muslin or cheesecloth should have the weight indicated on a securely attached card. The weight of a quarter, doubly wrapped, may be marked on the outer burlap covering on one or both sides of the quarter, along with such other markings as are required by the purchasing authorities for future identification. Sometimes 1 per cent allowance is made for freezing shrink.

In weighing frozen beef taken from stock, usually a suitable number of quarters are selected, stripped and weighed. If the trim does not conform to purchase requirements, a reasonable number of these quarters (at least 10) are trimmed, and the average deduction determined to apply to the entire lot.

Freezing. Beef intended for delivery to troops at a distance from transportation, for export or for storage purposes, is frozen to insure its proper conservation. It is very important that quarters selected for freezing are from recently slaughtered animals, and that they have been properly and thoroughly chilled. A thorough reinspection should be given at the freezer for soundness before freezing. Chilled beef shipped from a distance to a freezer in improperly iced cars becomes slimy in the fold of the flank and under the diaphragm. Such beef if frozen spoils rapidly on being thawed out. A trier inspection, at least should be made into the hip joint of all hindquarters to eliminate any quarters which are sour or decomposed in that region. After inspection, the quarters are placed into a sharp freezer at about 10° below zero F. Here they are hung on rails or spread on racks, properly spaced without any two quarters touching, and allowed to freeze about three days. The extent to which a carcass has been frozen can be determined by sawing through a heavy quarter at its thickest part or boring into the musculature with a 1 inch augur. The saw will make an even, smooth cut in frozen meat, but will tear the musculature and make a ragged, uneven cut in unfrozen meat. An augur, readily, will penetrate solidly frozen meat but refuses to cut unfrozen flesh. Solidly frozen meat will emit a resonant sound when struck with an iron bar; and unfrozen meat a dull sound. Quarters should be frozen solid before being stacked into piles. If only partially frozen when piled in a sharp freezer, beef quarters may require three weeks or more to freeze.

After thorough freezing as determined by tests, beef is placed into a holding freezer at 10°F. This tends to reduce excessive shrinkage. The average holding-freezer shrink on mature beef will vary. It is

about $1\frac{1}{2}$ per cent the first month and 3 per cent for six months' storage. After nine months of proper storage, in addition to some loss of moisture, beef acquires an old flavor; the fat becomes brittle and friction from other quarters causes it to crumble, somewhat; for a depth of 1 c.m. the meat becomes desiccated, fibrous and pulpy; the nutritive qualities of the deeper tissues remain unchanged and when properly defrosted, it is only slightly inferior to fresh, chilled beef. A ton of frozen quarters will occupy about 100 cubic feet in storage.

Boneless beef in moulds which are properly spaced in the sharp freezer at 10° below F., should freeze solidly in about three days. The form used contains the boneless meat from a quarter or about 100 pounds, and the frozen block of meat will occupy about $2\frac{1}{2}$ cubic feet. A ton of these wrapped blocks occupies about 50 cubic feet.

Shipment. Inspection at loading should include an examination of the dryness and cleanliness of the interior of the car, the hooks, hangers, and racks, and the state of repair of floor racks. All drain pipes should be open to prevent bunkers from overflowing, flooding the floor and saturating meat piled on floor racks.

Cars should be examined to determine whether they are properly iced, using not less than 15 per cent of salt, and are chilled to at least 40°F. before loading; and bills of lading and shipping orders, to ascertain that they contain instructions for daily icing adequate to insure arrival of the beef at its destination in good condition.

Chilled quarters are never piled into a car on floor racks as is frozen beef, but are hung on clean, galvanized metal hooks. There are many methods of hanging chilled beef in a car. Some packers hang the hind quarters in one end and the fore quarters, bone to bone and back to back, in the other end. Another may hang beef quarters in two layers, the hind quarters above, and the fore quarters below on long hooks. Sharp bones should not contact the outside flesh or fell, and fresh quarters should be wedged in as tightly as possible to prevent shifting and friction.

To prevent serious cuts resulting from sharp, ragged edges of bones, beef luggers should carry a left quarter on his right shoulder and a right quarter on his left shoulder thus keeping the bones away from himself.

In hanging hind quarters in a car, the car hook should be placed into the same hole in the gam cord where the hook of the roller truck originally was inserted. Forequarter hooks are inserted between the 9th and 10th ribs. The number and weight of chilled beeves which

can be packed into a refrigerator car will vary according to the capacity of the car, methods of hanging, size and class of the carcasses. Thirty-five steer carcasses averaging 600 pounds can be packed into a standard refrigerator car without difficulty. The average load for a standard refrigerator car is around 23,000 pounds.

Carload shipments of frozen beef are made in refrigerator cars which will hold about 22,000 pounds of frozen quarters piled on racks. Frozen quarters first are laid on the clean, slatted floor racks which have at least 4 inches clearance above the floor. Other quarters then are packed in the car as tightly and as high as possible. The uneven contour of the quarters does not permit of close packing.

To conserve refrigeration in hot weather, refrigerated vestibuled loading docks, or loading through a canvas curtain may be employed. After loading, canvas strips may be nailed on the car doors to maintain refrigeration.

(c) Reinspection. *General.* Veterinary reinspections are maintained after the selection of carcass beef, as is required by proper authority or as is deemed necessary by the inspecting veterinarian, at point of origin, in transit, during freezing, at delivery before final acceptance, at receipt at destination, in storage and at issue, both for compliance with the sanitary requirements of the Surgeon General and those of the purchasing authorities. This examination includes the sanitation of compartments and carriers involved; the sanitary handling, freezing, storage and shipment of the product; its soundness, condition, stamping and wrapping and temperatures under which handled or stored. It also includes reinspection at final delivery before acceptance, for soundness; and, quality, quantity or other factors as may be required by the purchasing officer. Record of all inspections and reinspections should be kept, and such reports made as are required, together with any recommendations.

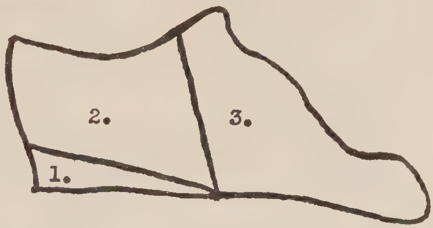
Inspection on Receipt of Shipment. Chilled Carcass Beef. Fresh beef should receive a piece inspection on receipt for soundness. The condition of the interior of the car and of the hooks or hangers with regard to cleanliness should be observed. The manner in which the beef is loaded and the temperature of the car should be ascertained before the meat is removed. Evidence of apparent carelessness or neglect in regard to shipping or handling should be noted. The surface of the meat should be examined for soiling or other signs of careless handling. Mold, bruises, and other abnormalities should be looked for. An indication of insufficient refrigeration is a slimy condition,

which is likely to appear first under the fore shank, beneath the periphery of the diaphragm, in the fold of the flank, on the neck, and on cut surfaces. If beef has been placed in the car before being thoroughly chilled, it may have a wrinkled appearance. This should lead to a thorough examination, as in such cases souring or putrefaction may have occurred in the deeper parts near the bone. A meat trier should be used to detect this condition.

Frozen Carcass Beef. Upon receipt of frozen beef the veterinary officer should observe marks of prior inspection, covering, cleanliness of the product, and give as thorough an examination as possible for evidence of diseased conditions. The examination of frozen beef as to lymph nodes and color, to be done properly, would require its being thawed out. As a rule this is not a practical procedure In case of imported Australian beef an examination should be made for nodules produced by Oncocerca gibsoni. When frozen carcasses or parts are covered with muslin or with muslin and burlap, piece inspection is not practicable except at final destination. However, the firmness of the meat and the condition of the surface as to dryness can be determined to a certain degree without removing the covering. When frozen meat is exposed to a comparatively high temperature, the surface thaws and becomes soft and moist. If softness or moisture is discovered, the carcass or part should be uncovered and cut through to determine the exact condition.

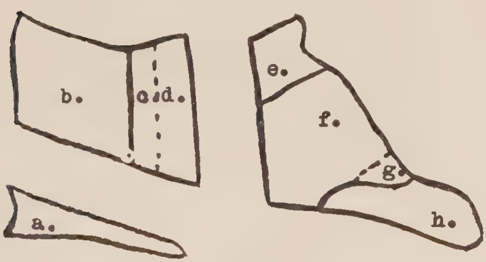
For oversea shipments, it is essential that a thorough sanitary examination, both superficial and deep, be given frozen carcass beef. It is important that quarters are sound throughout. Cases of hip-joint sourness and decomposition around the bone should be rejected. Where necessary, one test for decomposition which is of practical value, is to bore into the deepest tissues, using an augur, and subjecting selected shavings of musculature to a modified Eber's test conducted as follows: Prepare a solution consisting of pure hydrochloric acid 1, ether 4 and grain alcohol (absolute) 14. Shake well. Fill a chemically clean, glass test tube one-third full of this solution. Place a small piece of the beef musculature, to be tested, on a small, clean, tenaculum hook and holding the test tube in a slanting position, introduce the meat *almost* down to the solution. Decomposition, if present, is determined by white ammonium chloride fumes being evolved in the test tube. The sample to be examined should be defrosted and warmed to room temperature.

Inspection in Storage. Rooms in which fresh beef is stored should be dry and clean and kept at a temperature which will insure proper preservation. This temperature should not exceed 32°F. for chilled beef and 10°F. for frozen beef, such temperatures being taken with standard, registered thermometers, 4 feet from the floor. Sufficient ventilation is necessary for dryness and an equable distribution of temperature. Quarters should be hung with sufficient space between



Initial Cuts

1, Flank; *2*, Full Loin; *3*, Full Round



Secondary Divisions

Fig. 11. Standard Hindquarter Market Cuts of Beef

a, Flank; *b*, Pinbone Loin; *cd*, Loin End; *bc*, Flatbone Loin; *e*, Rump; *fg*, Buttock; *g*, Heel of the Round; *h*, Hind Shank.

them to encourage the free circulation of air. Beef held in a cooler for any length of time may become slimy or impregnated with mold. Reinspections of beef in storage should be made daily and temperatures noted.

When fresh beef must be held in cars until issued, the cars should be kept properly iced to capacity, using 15 per cent of No. 2 salt, and the doors opened as little as possible. The carcasses remaining in the car should be well spread out.

Inspection at Issue. This concerns the soundness of the product, its handling and transportation. A piece inspection should be made of beef at issue and only such meat issued as is sound and free from taint. The vehicles used for transporting beef should be clean, sanitary, adequate and adaptable. Wagons used to haul such articles as manure, coal or other contaminating substances are unsuitable. Open wagons should be provided with clean tarpaulins and beef should be kept free from floor, air or other contaminations. Attendants handling meat should have clean outer garments and hands, and should be free from disease. The inspection at issue includes the handling of the meat up to the point of delivery to organizations when it comes under the inspection of the general sanitary service.

c. Wholesale Cuts of Beef. (1) General. The Chicago method of ribbing sides, leaves one rib on each hind quarter and twelve ribs on each fore quarter. Each hind quarter represents about 24 per cent of the carcass weight, while each fore quarter 26 per cent. The wholesale beef trade is about equally divided into carcass beef and "straight" or wholesale cuts on their subdivisions. The straight cuts of a hind quarter are the round with rump and shank (R. & S.) on, loin and flank; and those of a fore quarter are the rib, square cut chuck, plate and fore shank. Suet is removed from the hind quarter when divided into cuts. Subdivisions of certain wholesale cuts also are made. Other cuts sometimes made are the Kosher chuck, hind and piece, piece, back, and triangle. (See Fig. 8.)

(2) Description of Cuts. (a) Hind Quarter Cuts. *General Description.* In breaking up a hind quarter of a steer into standard commercial cuts, the quarter is placed "bone-side" down on a table. The flank is removed by a straight incision from the cod fat to the middle of the ribbing cut, and the untrimmed loin is removed from the round by an incision from the posterior portion of the cod fat to the sacrococcygeal articulation. This cut should intersect the acetabulum and remove a piece of bone the diameter of a dollar from head of the femur. This incision produces an untrimmed loin and a round with the rump and shank on.

Untrimmed Flank. The flank is a boneless cut from the hind quarter anterior to the round and inferior to the loin. It represents about $3\frac{1}{2}$ per cent of the weight of the side. Untrimmed, it is termed the "Rough flank" being quoted as "steak in." Trimmed flanks may have the flank steak and some fat removed when they are quoted "steak out." Flanks are retailed as flank rolls, fresh or corned, or utilized in

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Upper. Choice Good
Lower. Medium Common

Fig. 12. Steer Loins

mess beef, canned corned beef or sausage. A rough flank may be divided into a flank steak, which is pulled; a small quantity of lean trimmings and fat. The flank steak, representing 10 to 17 per cent of the flank weight, is composed almost entirely of light, medium red colored muscle which is coarse-grained and quite often tough. It is used as a steak or roast. The trimmings are utilized in corned beef or sausage and the fat goes into tallow.

Untrimmed Loin. General Description. The untrimmed loin as removed from the hind quarter contains one rib and has the kidney knob (kidney and kidney fat) attached. It represents about 20 per cent of the side and is sold untrimmed or divided into the full loin and kidney knob.

Full Loin. General Description. A full loin, representing 17 per cent of the weight of a side, contains the choicest, most preferable and valuable retail cuts. It may be sold entire or divided at the hip bone (external angle of ileum or "pin" bone) into an anterior half, the regular, pinbone or short loin; and a posterior half, the loin end. The full loin sometimes is divided midway between the pinbone and the posterior (butt) end of the loin when the anterior portion is called the flat bone loin. This name is derived from the shape of the pelvic bone at the plane of division. The posterior portion also is known as a loin end. The psoas muscles when pulled from a full loin are termed the "tenderloin," "beef tender" or "fillet of beef." The remainder of the loin is the "strip loin."

Pinbone Loin. The regular short loin or rib end of the loin, is called the pinbone loin as it is divided at the "pin" or hip bone. From it are derived the porterhouse, T-bone and club steaks or it is used as a loin roast. The most posterior steak cut is the "pin" bone porterhouse steak and usually contains the tip of the external angle of the ileum. Club steaks are cut from the anterior or rib end. The short loin weighs 20 to 40 pounds.

Loin End. The posterior part of the full loin when removed is called the "Loin end." It is utilized for sirloin steaks and roasts.

Flatbone Loin. This cut averages 20 to 45 pounds.

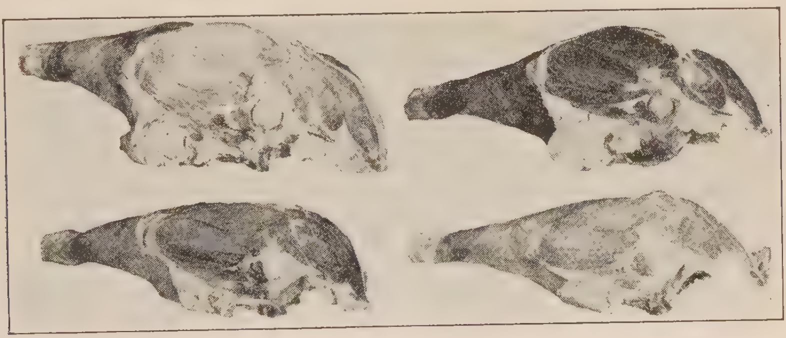
Tenderloin. The tenderloin, beef tender or fillet of beef isgenerally stripped from the poorer grades of full loins but may be pulled from market loins when it is necessary to bone them out on account of bruises. They weigh 2 to 8 pounds. Those weighing less than 3 pounds are called, "Strip tenders," "Shoestrings" or "T-strips."

Strip Loin. General description. Full loins with the tenderloin removed are called "Strip Loins" or "Strips." They average 7 to 15 pounds. Usually a strip loin is divided at the pinbone into a sirloin strip (stripped short loin) and a sirloin butt (stripped loin end).

Sirloin Strip. When boned, they are known as "Boneless strips" and weigh 4 to 8 or even 12 pounds apiece.

Sirloin Butt. When boned, they are known as "Boneless butts" and weigh 3 to 6 or even 8 pounds apiece.

Kidney Knob. A kidney-knob includes the kidney and kidney fat. In breaking up a hind quarter, the kidney knob remains attached to the untrimmed loin. It may be sold attached or removed and sold as suet. Kidneys may be removed and sold separately.



(Permission United States Bureau of Agricultural Economics)

Upper. Choice — Good
Lower. Medium — Common

FIG. 13. STEER ROUNDS

Full Round. General Description. The full round is the posterior part of a hind quarter after the untrimmed flank and untrimmed loin have been removed. It represents 23 to 24 per cent of the side. Unless otherwise specified it is quoted as "Round, R. & S. on," i.e., with rump and hind shank on. It may be divided into the shank (hind shank), rump and buttock (round) or a beef ham set may be derived from the hind leg as is described later. Differentiation of full rounds, as to sex, can easily be made. (See "Beef Classes".)

Hind Shank. This is disarticulated at the stifle joint and represents 26 per cent of the weight of the full round. It may be sold as a soup bone, or boned out into meat 42 per cent and bone 58 per cent. The shank meat goes into hamburger, sausage or other prepared products and the bone into bone products.

Rump. The most superior part of the full round is called the "Rump." It is removed by cutting inferior and as closely as possible to the pelvic bones. It represents 14 per cent of the weight of the full round. It is utilized in corned beef or as a pot roast or it may have the pelvic bones removed, leaving three coccygeal segments (tail bones) of bone attached when it is known as a "Rump Butt" or "Boneless Rump." It weighs 5 to 7 pounds and commonly is used for corned beef.

Buttock. The buttock or round proper equals 60 per cent of the weight of the full round and is quoted as "Round, R. & S. off." It contains a large percentage of lean meat and a small amount of bone and fat. The round may be considered as having two portions, the "top," "inside" or "twist," and the "bottom," "outside" or "thigh." The "inside" has more thickness and is more tender than the "outside." The flesh is light, cherry red in the upper portion and gets slightly darker toward the shank, possibly due to more exercise given the latter muscles during life. The fat which is small in amount is confined to the region of the rump, the upper part of the round, on the inside gradually diminishing toward the shank. A marbling effect may be present in the upper part of high grade rounds. The round is used for steaks. The inferior end of the round, or "heel" is used for a roast. A boneless buttock, or "Scotch buttock" may be made from better grades of rounds. Low grade rounds sometimes are boned out and corned, or the "inside" used for steaks and the "outside" for roasts.

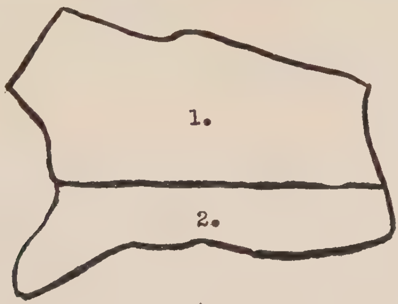
Beef Ham Set. General description. A round intended for curing is cut longer than a regular buttock being cut in such a manner that part of the musculature which ordinarily is a part of the loin end remains attached to the round. This gives a greater length and amount of lean meat to the knuckle. The musculature of the buttock then is stripped from the bone being divided into three pieces, the "inside," "knuckle" and "outside" called a "Beef Ham Set" or "Dried Beef Set."

Inside. This is the largest, thickest and most desirable of the three pieces, coming from the inside of the hind leg and represents 42 per cent of the weight of the set.

Knuckle. The knuckle is the muscular portion of the round ("Crural triceps consisting of the rectus femoris, vastus externus, vastus internus and anterior gracilis muscles."—Richardson) in front of the thigh bone, and it may contain the patella or "knuckle bone." It represents 27 per cent of the weight of the "set" and ranks next to the inside in point of value.

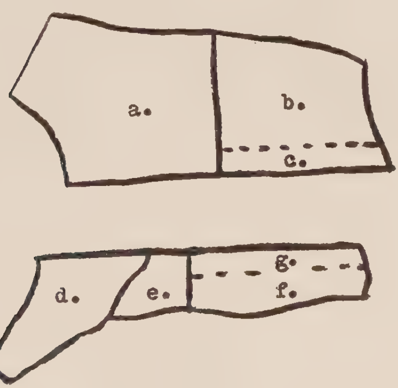
Outside. The "Outside" is from the outside of the leg and represents 31 per cent of the weight of the set.

(b) Fore Quarter Cuts. *General Description.* For market cuts, the fore quarter of beef is divided by cutting and sawing into a superior and an inferior portion. The line of incision is from the middle of the



Initial Cuts

1, Back; *2*, Full Plate and Fore Shank



Secondary Divisions

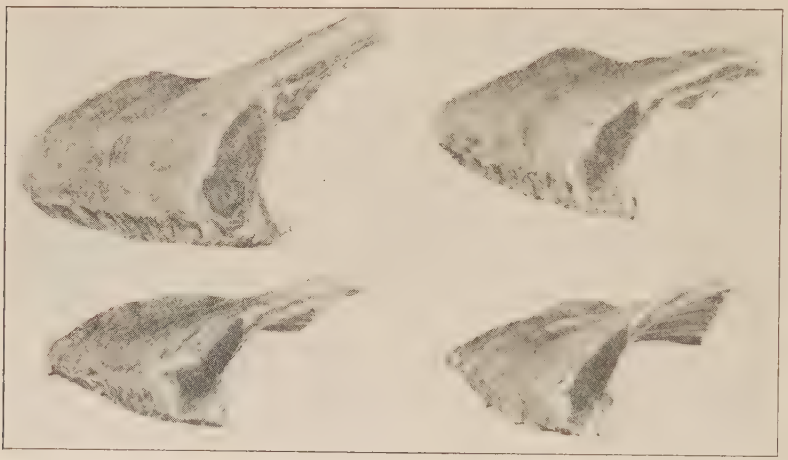
Fig. 14. Standard Forequarter Market Cuts of Beef

a, Square Chuck; *bc*, Rib; *c*, Rib Ends; *d*, Fore Shank; *e*, Brisket; *fg*, Navel End; *g*, Short Ribs.

ribbing cut at the 12th rib to a point midway between the shoulder and elbow joints of the fore leg. The superior portion or "Back" is further divided by cutting between the 5th and 6th ribs, then sawing through the vertebrae. The anterior cut is called the "Square Chuck" and the posterior part, the "Rib." From the inferior portion of the quarter,

the "Fore Shank" is removed leaving the "Full Plate" which may be divided between the 6th and 7th ribs into an anterior portion or "Brisket" and a posterior portion or "Navel End." Other cuts sometimes are made as are hereinafter described.

Square Chuck. The beef chuck, square cut, contains the superior portion of the first 5 ribs and the neck. It represents 26 per cent of the weight of the side and is retailed as steaks, boiling pieces and roasts. The neck and neck trimmings may be used in stews, mincemeat, sausage and other prepared products.



(Permission United States Bureau of Agricultural Economics)

Upper. Choice — Good
Lower. Medium — Common

FIG. 15. STEER RIBS

At the initial division of a fore quarter, the shank may be removed at the shoulder joint (knuckle) with part of the shoulder clod. The chuck then, is quoted, "Knuckle Out" and the shank quoted as "Clod On." A low grade chuck may be cut "Knuckle out," with the shoulder clod pulled, and then freed from the scapula or blade bone, the ribs and vertebrae, when it is quoted as a "Boneless Chuck." The shoulder clod is a boneless, muscular piece weighing from 6 to 15 pounds. It is removed from the muscular portion of the arm, superior to the elbow, posterior to the humerus and extending over the posterior part of the lateral face of the scapula (infra-spinous fossa). It is used for steaks, roasts or dried beef.

A Scotch clod, the inner portion of a chuck beneath the blade bone, is sometimes made from a boneless chuck. This is an "export" cut.

Rib. General. The rib, prime or standing rib, contains the superior portion of seven ribs (6th to 12th, inclusive), attached split vertebrae and the feather edge of the blade bone. It represents 9 per cent of the weight of the side, weighs 16 to 55 pounds and is used for roasts and sometimes steaks. Ribs and loins, representing 26 per cent of the weight of the carcass, frequently are sold in "Sets." "Rib Ends," 2 to 4 inches long are made from the lower end of the "Rib." They are used for roasting purposes.

Rolls. Regular Roll. From the lower grades of ribs, boneless rolls are made. The regular roll is the lean part of the rib, minus the vertebrae, feather edge of the scapula, fat and the outer layer of meat. It weighs 4 to 8 pounds and is used for small steaks.

Spencer Roll. This roll is of better quality and heavier than the regular roll. The fat and outer layer of lean are allowed to remain on excepting a portion above the scapula. They average 6 to 12 pounds and are used for roasts and steaks.

Fore Shank. This cut is also called the "Shank" or "Shin." When cut from the square chuck it is called a "Regular" or "Clod Off" shank, and weighs about 4 per cent of the side. It is sold as soup meat and for stews. It may be boned, the shank meat (55 per cent) used for sausage and the bone (45 per cent) for marrow and bone products. Shanks, clod on, are described under "Square Chuck."

Brisket. This is the anterior end of the full plate and represents 4 per cent of the side. It is used principally for corned beef. It is also boned, cured and smoked.

Navel End. The navel end, navel or plate, is the posterior portion of the full plate, representing 8 per cent of the weight of the side. It has a high percentage of fat and is used for corned beef, barrel mess beef or is boned and used for rolled roasts, stews or made into sausage.

The rib end of the plate, 4 to 6 inches wide, may be removed, when it is called the "Short Ribs."

(c) Miscellaneous Cuts. These include the Kosher chuck, hind and piece, piece, back and triangle. Suet is discussed under "Kidney Knob" and "Beef Trimmings." A side may be ribbed between the 5th and 6th ribs when the anterior portion is called the "Kosher Chuck" and the posterior portion the "Hind and Piece." The "Piece" is the rib and navel together. The "Back" is the rib and square cut chuck in one piece. The "Triangle," "L," "Knockout" or "Rattle" is the fore quarter with the rib removed.

In order of their market value, the standard wholesale market cuts of beef are the loins, ribs, rounds, chucks, full plates, flanks and shanks.

Relations of Wholesale Beef Cuts to Dressed Carcass Weight

WHOLESALE CUT	EXTREME RANGE PER CENT	AVERAGE PER CENT
Loins	15-19	17.0
Ribs	8-11	9.0
Rounds	20-26	23.0
Chucks	21-27	26.0
Briskets	4-5	4.5
Navels	8-11	8.5
Flanks	2-5	4.0
Shanks	3-7	4.0

Suet, i.e., the kidney, crotch, suprasternal and other semi-loose fats obtained from carcass beef, represents 2 to 7 per cent of the carcass weight, with an average of 4 per cent. These fats are sold as such or made into tallow. (See "Kidney Knob.")

(3) Grades. The grade for a standard wholesale market cut of beef is the same as that of the carcass from which it is derived. (See Grades of Carcass Beef.) Class distinction while sometimes designated is not always material. To determine the grade of an individual beef cut, the soundness, conformation, thickness, covering or finish, quality including age, and weight, are considered. The conformation depends largely on thickness or the amount of lean meat, which is of prime consideration. Covering is essential in the more valuable cuts. The quality of a beef cut can be determined better after removal from a quarter and is indicated by the color, firmness, texture, and marbling of the flesh; the size, color and texture of the bones; the color, firmness and distribution of the fat and the proportion of lean meat, fat and bone. The meat should be firm. Ripening improves firmness. Firmness due to a dry, coarse, fibrous musculature is objectionable. Meat should not be soft, wasty or gluey. Meat should have a fine texture or grain and the cut surface should be glossy, velvety and smooth and not coarse or stringy. Color may indicate the class, quality, including age and other conditions. It should be a bright, rich, cherry-red. Pale musculature may indicate immature beef. Dark color may indicate improper feeding, advanced age, overheating or pyrexia at slaughter, improper bleeding, exposure of the meat to a warm atmosphere, absence of finish or poor quality. Fibrillar muscular rupture is an unsoundness that would place a cut into a "No Grade" status. (See

"Soundness" under "Carcass Beef.") Coarse, hard bones usually are present along with stringy, coarse flesh. Low grade cuts sometimes are referred to as "Strippers" being made into boneless cuts and prepared products.

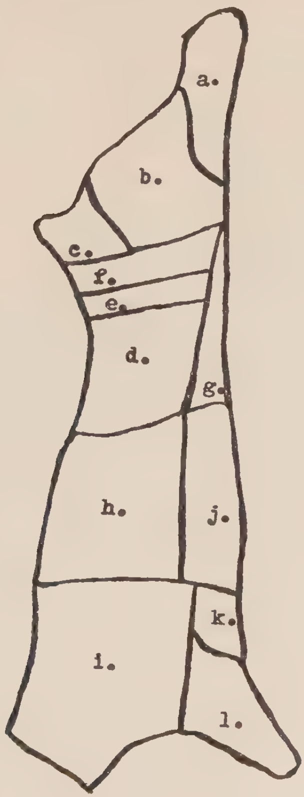


FIG. 16. STANDARD WHOLESALE MARKET CUTS OF BEEF
(*Adapted from Hall*)

a, Hind Shank; *b*, Buttock; *c*, Rump; *abc*, Full Round; *d*, Pinbone Loin; *ef*, Loin End; *de*, Flatbone Loin; *f*, Loin End; *def*, Full Loin; *g*, Flank; *abcdefg*, Hindquarter; *h*, Rib; *i*, Square Chuck; *hi*, Back; *j*, Navel End; *k*, Brisket; *jk*, Full Plate; *l*, Fore Shank; *hj*, Piece; *ikl*, Kosher Chuck; *hijkl*, Forequarter; *abcdefghj*, Hind and Piece; *ijkl*, Triangle.

(4) Army Requirements. These in general are the same as for carcass beef. Reference also should be made to current War Department purchase specifications.

d. Beef Trimmings. (1) Lean Trimmings. (a) Commercial Production. Beef trimmings include large, boneless pieces of lean meat too deficient in thickness, finish and quality to be used for market cuts and smaller, irregular pieces from cutting and boning out rooms. Their prinicpal source is from chilled, cutter and canner cattle; from hot or chilled, bull carcasses and from old freezer stock.

Cattle of the lower grades are most abundant in the fall of the year which is known as the cutting season when large quantities are boned out into boneless cuts and trimmings, and frozen to be used during the season when the supply is short.

In making straight and boneless market cuts, considerable quantities of scraps of various sizes and shapes result, some of which are trimmed from irregular bony structures.

According to size of the pieces, proportion of fat and lean meat they contain, and the part from which derived, trimmings are graded out as No. 1 and No. 2 trimmings. No. 1 trimmings are the larger, lean pieces, comparatively free from fat as derived from the pillars of the diaphragm, chuck, neck and brisket. No. 2 trimmings are smaller pieces having a larger proportion of fat, as those from the rib, flank, navel end and loin.

According to quality, trimmings may be graded out commercially as "Very Stale," "Stale" and "Fresh." Very stale trimmings are from beef with considerable age since slaughter, or which are slimy, musty and mouldy. Stale trimmings are only slightly slimy, musty or mouldy. Fresh trimmings, chilled or frozen are from beef which do not show any cooler age.

Fresh trimmings are graded out and packed for shipment in slack barrels or 100 pound boxes. For freezing, they are packed in shallow boxes, lined with cheese cloth or paper. They may be dry cured on trays or in tierces and sold as "Curene Trimmings." When used fresh, frozen trimmings are defrosted. Frozen blocks of trimmings may be cut into slices to enhance this process. When used for canned meats, fresh trimmings may be soaked in clean, cold water several hours, to improve the color of the resultant product.

Commercially, stale and very stale trimmings may be "breached" in cold water, a mild plain pickle or in second pickle, twenty-four hours, then scrubbed and placed into a regular long cure.

Cutting Test for Canner Cattle
(*Packers' Encyclopedia*)

	per cent
Sirloin butts	3.903
Strips	4.204
Tenderloins	2.552
Boneless chuck	13.813
Rolls	2.552
Plates	12.162
Insides	7.957
Outsides	5.555
Knuckles	5.555
Clods	5.105
Rump butts	2.402
Flank steak	0.600
Tenderloin	0.450
Front shanks	7.207
Hind shanks	4.650
Soft bones	6.906
Trimmings	8.108
Tallow	1.200
Kidneys	0.600
Tankage and marrow	4.519
	100.00

(b) Army Requirements. Beef selected for prepared products intended for the Army should meet the sanitary requirements of the Surgeon General, and if purchased under the Quartermaster General, such purchase requirements as may be specified.

Trimmings, from carcasses which have not passed satisfactory, recognized, veterinary ante-mortem and post-mortem examinations in accordance with Army Regulations; or containers of which do not bear the official "Passed" inspection legend of an authorized inspection agency; or trimmings which have not been properly stored or handled in a clean and sanitary manner and those which are unsound in any measure, have a "No Grade" status and should be rejected. Fresh trimmings must be in good condition both inside and outside. Stale or very stale trimmings should be rejected. This includes those which have been processed or "Breached" in any manner.

For canned meats, trimmings should be from strictly fresh beef in prime condition from steer or cow carcasses of good canner quality, the meat to be subject to Army veterinary examination both in the carcass and at any time thereafter. The thoroughly chilled carcasses should be inspected on the rail before they are quartered and rejection

made of any of a "No Grade" status, to include those which have had large bruises, abscesses or adhesions; or which are thin, emaciated,

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FIG. 17. CANNER COW CARCASS

washy, slimy, slippery, mouldy or partially decomposed. Bull and stag carcasses are not desirable as a rule.

Quarters should be boned out. Certain cuts as the loin, tenderloins and rounds may be used by the packer. Kidneys, suet, skirts,

flanks, shanks, head meat, bloody end of the neck, and offal meat should be excluded. The pieces should be sorted out and all bones, cartilages, tendons, skinny and gross connective tissues, excessive fat, and bruised, sloppy or otherwise unsound or unfit portions, rejected. Benches, containers, implements and other equipment involved should meet the sanitary requirements of the Surgeon General. Trucks should be clean, tagged, and if the meat is transported some distance, the trucks should have an adequate, sanitary covering.

Where any or all cuts may be used, an inferior product usually results as there is a decided inclination to use small trimmings, rib covers, thin loins and other unsuitable cuts which cannot produce a high grade product. For canned, roast and corned beef, 50 per cent of chuck meat and 50 per cent of plate with the skirts removed seem desirable. For corned beef hash, briskets which have been "Long Cured," are desirable.

Commercially, hot or chilled bull meat sometimes is used for sausages. Usually No. 1 trimmings from beef hams or boneless chucks and No. 2 trimmings as shank meat and miscellaneous pieces from any part of dressed carcasses also are used.

(2) Fats. Cutter and canner (stripper) carcasses contain a small amount of kidney, flank and other fats which are rendered into tallow.

(3) Bones. (See "Cutting Bones—Beef Offal.")

3. Fresh Veal. a. Offal. (1) General. The handling of calf offal does not materially differ from that of cattle.

(2) Blood. Calf blood is dried, ground and made into fertilizer or blood meal for stock food. Calves average 4.15 pounds of blood per head, and will yield 0.8 to 1.20 pounds of dried blood according to size of calf and the percentage of moisture in the finished product.

(3) Hide. (a) General. (See Calf Slaughter.) As a rule calf skins are not removed on the killing floor but later after the carcass has been chilled. They are inspected and graded in the curing cellar.

(b) Grades of Calf Skins. (United States Department of Agriculture Farmers Bulletin 1055):

Kipskins are heavy calfskins weighing from 15 to 25 pounds. They are graded as No. 1 and No. 2.

Branded kipskins are skins carrying side or butt brands. They are graded as No. 1 and No. 2.

Heavy calfskins weigh from 8 to 15 pounds. They are graded as No. 1 and No. 2.

Light calfskins weigh from 7 to 8 pounds. They are graded as No. 1 and No. 2.

Deacon skins are from newly born calves.

Slunk skins are from stillborn calves.

(c) Curing. This is much the same as for cattle hides, care being taken to prevent stains from impure salt or other contamination.

(d) Disposition. Calf skins are sold to tanners and are more valuable than cattle hides. Trimmings are made into glue. A small amount of skin remains on shaved heads and legs intended for edible purposes.

(4) Legs. The handling and disposition of calf legs are similar to that of cattle. Some are removed with the skin on, scalded, shaved and used for edible purposes. Some go for gelatin manufacture.

(5) Head. Sometimes the skin may remain attached when it is scalded, shaved, the head cleaned thoroughly and used entire for edible purposes. Otherwise heads of calves are handled much the same as cattle heads. The brain is sold fresh or frozen. The cheek and head meat are sold fresh or frozen or are placed into sausage or tallow. Tongues are sold fresh or go into sausage or are canned, and the skulls are rendered into tallow, glue or made into crushed bone products.

(6) Genito-Urinary Organs.

(a) Testes or "fries" from male carcasses should be removed and rejected.

(b) Bladders may be rendered into tallow, or trimmed, washed, inflated, etc., as for cattle bladders.

Grades of Calf Bladders

(*Packers' Encyclopedia*)

Small Calf Bladders, to measure 4 inches to 6 inches across widest part, 24 pieces to the bundle, tied on both ends, packed 125 bundles or 3000 pieces to the barrel, and marked "Small Calf Bladders."

Large Calf Bladders, to measure 6 inches and over across widest part, 24 pieces to the bundle, tied both ends, packed 100 bundles or 2400 pieces to the barrel, and marked "Large Calf Bladders."

(7) Abdominal Viscera. (a) Caul. This goes to the oleo department.

(b) Oesophagus. The weasand is rendered into tallow.

(c) Stomachs. The first three stomachs are rendered into tallow and fertilizer. The fourth may be rendered into tallow, sold to cheese makers or made into rennet. The fourth stomach of calves which have been fed exclusively on a milk diet, is washed, macerated in salt brine and the rennet recovered in a dilute impure form. This is evaporated and concentrated to powder form and made into tablets. It is

used by cheese manufacturers to coagulate milk casein (sweet curdling), the calcium caseinate being split by rennet into calcium paracaseinate and whey-proteid.

(d) Intestines. Usually intestines are rendered into tallow and fertilizer. As casings they are not relished, and when saved are put up separately.

(e) Liver. The liver is smaller and lighter in color than the average beef liver. On account of its tenderness and usual freedom from parasitic and diseased conditions it is sold at a premium, usually in a fresh state separately or with the pluck.

(8) Thoracic Viscera. The pluck, including the liver, may be sold whole or separated into its different parts, the portions not otherwise utilized being rendered into tallow.

(a) Lungs. These may be rendered into tallow or used for food purposes under the same restrictions as for cattle lungs.

(b) Hearts. Calf hearts are washed in water, cleaned, trimmed, placed on trays, chilled and go into sausages and potted meats. If to be held they are frozen.

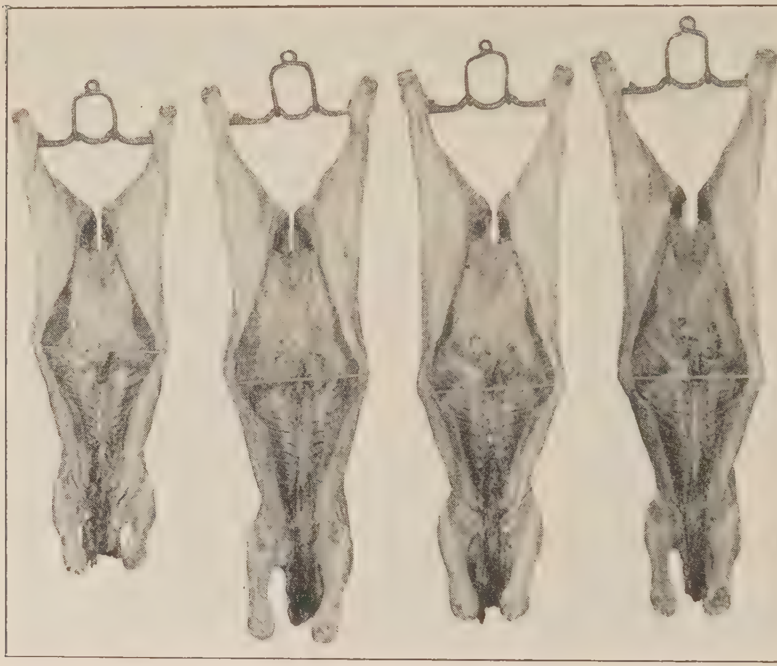
(9) Miscellaneous. (a) Thymus Gland. The thymus gland or sweetbread of the calf is pale in color and occupies the greater portion of the anterior mediastinal space, extending to the aortic arch while the cervical portion extends from the thoracic inlet along the oesophagus and trachea to the thyroid gland. It sometimes weighs 2½ to 3 pounds and is more meaty, tender and desirable than cattle sweetbreads. They are trimmed, inspected, placed on trays and chilled. The best sweetbreads are wrapped separately in waxed paper. They are packed in wooden boxes or in tin pails and sold fresh or frozen. Chilled sweetbreads are very perishable, as they deteriorate rapidly. A substance is made from the thymus gland. (See Cattle Offal.)

(b) Miscellaneous fats are placed into oleo stock, tallow or rendered as inedible, if dirty. Scrap trimmings go into glue and fertilizer.

b. Carcass Veal. (1) General. (a) Veal, Defined. Veal is the flesh of calf carcasses of different types, breeds, ages, sizes and weights. The minimum and maximum requirements usually are based on the physical development into mature veal on the one hand, and the age where veal characteristics leave off on the other. Weight and size are not always indications of maturity; as, for example, some large framed "Skimmers" may be undernourished and weigh from 35 to 350 pounds. Certain state and municipal ordinances prohibit the sale of calves under a specified weight or age, as under 40 pounds or

ten days to three weeks of age. Some authorities discuss veal as pertaining to the dressed weight of calves up to 300 pounds, or up to three, six or even twelve months of age.

(b) Utilization. Ninety per cent of veal is sold fresh as carcasses or cuts. During the late summer and autumn considerable quantities of "Western" veal, 100 to 180 pounds dressed, are split into halves,



(Permission United States Bureau of Agricultural Economics)

Choice Good Medium Common

(Ventral view)

FIG. 18. CARCASS VEAL

enclosed in muslin or stockinette coverings and frozen for the winter trade. A small part may be cured, canned or used in other prepared products.

(2) Classes. (a) General. Classifications are more or less arbitrary and many difficulties are encountered in trying to classify out immature forms such as calves. Because of their lack of uniformity, frequently no effort is made to classify carcass veal but merely to grade them out under designations referring to type, sex, conditions

of feeding, state of nutrition, maturity, methods of dressing, inspection, age and weight.

(b) Type. This refers to dairy and beef types and needs no amplification.

(c) Sex. Sex of carcass veal is of little importance and is seldom considered as it is not of sufficient importance to influence the grade, development, conformation, yield or quality. They may be designated as bull, heifer, spayed or steer calves. Some buyers prefer heifer calves.

(d) Feed. Feed is reflected in the quality, condition and finish of carcass veal. Suckling, milk fed, butter-milk fed, and skim milk fed calves may have a bright flesh and clear white baby fat. Feeders, pasture or grass fed animals subsisting on coarse feed are sometimes poorly nourished. Usually they have a coarse grained, dark-colored flesh and firm white to green-yellow fat.

"Natives" are calves of the beef or dairy types apparently well fed or fattened on a milk diet, confined with little exercise and properly sheltered. Usually they are shipped short distances, if any, and represent the most salable and properly finished veal. Many choice individuals of the beef type are included. The hair is long, soft, and tail bushy; the flesh is light colored and fine grained, the fat clear and white and the bones contain considerable red bone marrow, being spongy and soft.

"Westerns" are those having been fed little milk and, with much exercise. They may have been transported long distances, especially on foot, and include "range" calves. They do not grade out as well as natives. The hair is short and straight, lying close to the skin. The tail is small and like a whip lash. The meat is coarse grained and dark colored due to insufficient nourishment. The bones do not contain as much red bone marrow, being less spongy and whiter than those in natives and usually show greater age.

(e) Nutritive Condition. Veal carcasses may be designated as lean or fat. Insufficient nutrition results in a dark colored, coarse grained flesh.

(f) Maturity. Calves may be immature, mature or overmature for veal.

(g) Methods of Dressing. Carcass veal may be dressed "Hog Style;" each carcass having the head and feet removed, opened down the inferior median line from the tail to the throat, through the hench and breast bones, and with the hide left on. This last retains the

moisture preventing the surface from becoming dry, and preserves the fresh appearance and color, preventing the meat from becoming dark before consumption. Some heavy and other veal carcasses (see "Calf Slaughter") have the hide removed at slaughter but not split, while the very heavy or "split" veal and "baby" beef have the skins removed and are split at slaughter. Veal may be dressed pluck in or out. When sold to the Army, local dealers, or on going into the freezer veal carcasses are skinned immediately before reinspection and delivery. For the Army, the pluck is removed. For shipment in commercial trade, unless some sanitary reason prevents, calf carcasses may be transported with the hide on as a protectant against contaminations. For handling, carcasses usually are split into two equal sides (rarely quartered), or divided into saddles and racks.

Kosher killed animals are quartered, the fore quarters, including 12 ribs are used by the Jewish trade while the hind quarters are sold commercially.

(h) Inspection. Veal may be designated as inspected, farmer killed and non-inspected. Inspected veal is that which has passed the Army Veterinary, or other official and competent sanitary inspection as provided in Army Regulations. Farmer killed stuff may be inspected as noted in Chapter V, section B, paragraph 5. Non-inspected veal should be rejected. About one-half of the calves in the United States are slaughtered by farmers, local butchers and wholesale slaughterers not under Federal Inspection.

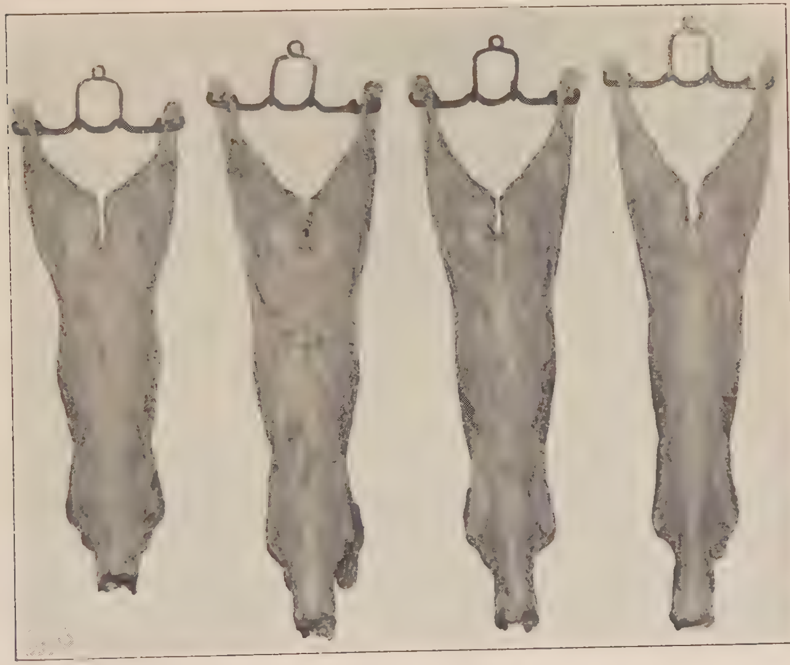
(i) Age. The major calf crop is in the spring of the year, April and May. The larger part of veal calves, the bulk being males of the dairy type, are slaughtered within a few weeks after birth. Many are allowed to mature longer, thus the ages, sizes and weights progressively increase with time until the succeeding calf crop.

Therefore, according to age we consider the fetus, the undeveloped calf too immature for veal, genuine veal, heavy or "split" veal and "baby" beef.

Fetus. The characteristics of the fetus and its disposition are treated in "Post-mortem Inspection of Calves."

Undeveloped or Immature Veal. Calf carcasses lacking physical development are discussed in "Ante-mortem Inspection of Calves." "Deacons" are day old calves. "Bob Veal" is mostly of the dairy type between one and ten days of age, or strictly speaking, as the regulations specify the minimum requirements of development, it relates to immature veal carcasses lacking physical development.

Genuine Veal. These are veal carcasses from the time they are mature enough for veal up to the time they are six months old. They are most salable from four to six weeks of age, however, the quality is not high as the flesh lacks uniformity, is inclined to be soft, moist, watery and flabby. At this stage the color is pinkish brown, there is a large amount of pearly white cartilage, the bones are soft and



(*Permission United States Bureau of Agricultural Economics*)

Choice Good Medium Common

(Dorsal view)

Fig. 19. Carcass Veal

contain considerable red bone marrow and the fat is characteristic of milk feed (baby fat). At eight weeks there are many choice carcasses with tender, firm, smooth grained flesh. From eight weeks to three months of age they are at their best, being influenced by the type and feeding. From three to six months the flesh approximates more the color and consistency of beef, being darker, slightly red, coarser grained firmer and tougher; the fat shows slight evidence of milk feed, being

firm and white to a greenish yellow color due to grass, and the bones are larger, stronger and whiter. As age increases a corresponding increase in size and weight of carcasses occurs.

Split Veal. These are large, heavy veal carcasses six months or older, retaining the characteristics of veal (see "Quality" under Grades) yet so large that splitting is required at time of slaughter. They are on the border line between veal and beef because of the character of the flesh, the age, size, weight and manner of dressing. They are not sufficiently developed and finished for "baby" beef. Many Western calves six to twelve months old are included. The flesh while simulating the color and texture of genuine veal, however, is relatively light red in color and coarse, approximating that of beef. According to grade the flesh may be firm or watery, fine or coarse grained, well finished or lacking in finish. The bones may be unduly large, harder and whiter than in veal but softer, more spongy and containing more red bone marrow than beef. Cartilages are pearly white.

Baby Beef. This refers to bovine animals heavier than heavy veal, having the characteristics of beef but under one year of age. Baby beef are in their prime at about nine months of age. (See Carcass Beef.)

(j) Weight. Carcass veal is quoted on the gross weight, except when skinned calves are specified, therefore, the most logical basis for the classification of genuine and split veal is that of weight as follows:

	pounds
Light Weight	40 to 69
Medium Weight	70 to 119
Heavy Weight	120 to 199
Split Weight	200 to 300

The weight varies with the season, being the least in April and May and steadily increases until the next year. The most desirable weight is from 80 to 120 pounds. A sub-division of medium weight, "Handy Weight," is used to indicate a prime, blocky, well proportional veal carcass of 70 to 89 pounds. Weight is also a factor in grading carcass veal (see Methods of Grading). Weights of dressed carcass veal below 50 pounds are discriminated against.

(3) Methods of Grading. (a) General. The definite factors which determine values and differentiate the grades of carcass veal are form, thickness, finish, quality, weight, age and soundness. These factors are always present in varying degrees and are interrelated. The summarization of the extent of these variations furnishes a basis for arriving at some definite grade. (See Figs. 18 and 19.)

(b) Form. This has reference to the build or shape of the carcass and the proportion of its parts, being more important in older calves. The difference in form between beef and dairy types is not always pronounced. Well nourished calves of both types may produce carcasses with ideal form and conformation, i.e., with a short, compact, blocky build, broad hips, loins and shoulders, and short, thick, meaty shanks. Undernourished calves and poor individuals may produce a comparatively sharp, thin, narrow back, loins and hip and a heavy breast.

(c) Thickness. This relates to the amount of lean meat on the carcass as shown by full, thick rounds, loins and ribs. It is an important factor closely related to form.

(d) Finish. This has reference to the amount and distribution of fat over the interior surfaces as in the crotch and around the kidneys; over the external surfaces as in the fell and on the brisket, flank and rump. It also includes quality or palatability of the flesh as is dependent on the degree of fatness. The better grades of well nourished milk fed veal carcasses have a greater average amount of finish while poor, thin, undernourished veal are deficient in fat. In the better grades the caul, also contains more fat. Lack of finish may show in a dry dark colored fell. Marbling is never present even in the best finished carcasses.

(e) Quality. While influenced by age, weight, size and type, the quality of the different components or tissues which make up carcass veal is the most important factor in grading.

Flesh of high quality from milk fed calves has a light, bright pinkish brown color. It is firm and fine grained with a smooth, velvety appearance to the cut surfaces, denoting tenderness. Flesh, low in quality may be soft, watery, flabby, rough, irregular, coarse grained and dark.

Fat of high quality should be white, firm, abundant over the kidneys and in the crotch with a thin layer over the back. In carcasses of low quality the external and internal fat may be scarce or entirely lacking.

Bones should be small, fine and soft, with considerable red bone marrow as may be seen in the vertebrae and ribs. Cartilage should be abundant, soft and pearly white. Unduly large, white, hard bones with a smaller amount of red bone marrow indicate a low quality.

Skin of high quality should be soft and mellow with soft hair. Low quality is shown by a harsh, firm, tight skin and short, coarse hair.

(f) Weight. The rating of veal carcasses in the lower grades is greatly influenced by weight. The variation in weights also affects the grading in the higher grades. (See "Classes.")

(g) Age. This is an important factor in grading. Age directly influences the tenderness and palatability of the meat, which is more desirable from young milk fed animals than older grass fed calves (see "Classes"). Evidence of the degree of age may be found in the size of the carcass, character of the flesh, color and hardness of the bones, and color and character of the fat. In young veal the interior "baby" fat is soft, spongy and clear milk white, lacking brittleness, Older veal carcasses show less interior fat which is firmer, more brittle and of a yellowish creamy tint.

(h) Soundness. Veal carcasses which have not passed a satisfactory recognized veterinary examination in accordance with Army Regulations, those not bearing the inspection legend of an authorized sanitary inspection agency, or which have not been properly stored or handled subsequent to inspection, and those unsound, unwholesome or unfit for human consumption in any manner, have a "No Grade" status. In grading out carcass veal the Army Veterinarian should require skinning of the carcass after chilling and before grading to enable an adequate examination for fractures, bruises and other lesions, taint, etc.

(4) Grades. (a) General. Under any or several of the designations given under classes, veal carcasses may be graded out according to the 7 points given under the methods of grading. Carcasses may be graded No. 1 or Choice, No. 2 or Good, No. 3 or Medium, No. 4 or Common, No. 5 or Canner or, "No Grade." The better grades are usually found in the medium weights, then in light veal, heavy veal and split veal respectively. Split veal because of age, weight, size and unfinished condition is lowest in quality and contains no choice grade carcasses in this class. (See Figs. 18 and 19.)

(b) No. 1 or Choice Veal Grade (Bureau of Agricultural Economics):

A No. 1 or choice veal carcass fulfills every requirement of the most critical judge. It is relatively short, compact and blocky with broad shoulders, back and hips. Plumpness is evident at all points and especially in the regions of the preferred cuts, such as loins and rounds from which steaks or cutlets and chops are obtained. The neck is short and plump and the legs are short and well fleshed. The bones of the spine are soft and red, and tipped with relatively large and soft pearly cartilages. The "baby fat" is abundant over the inner walls, especially over the kidneys and in the crotch. The back is covered with a thin layer of fat and a moderate amount of fat is present in the muscle seams. The

flesh is of pinkish brown color, fine grained, firm or velvety to the touch, with a marked absence of excessive moisture so prevalent in the lower grades.

The evidences of the No. 1 or choice grade enumerated in the foregoing do not vary materially in the different classes. Very few heavy weight and no split veal carcasses are found in this grade. Heavy calves that have been fed sufficiently to fall in this grade, usually exceed the weight of split veal and are known as baby beef.

(c) No. 2 or Good Veal Grade (Bureau of Agricultural Economics):

A No. 2 or good veal carcass is above the average in quality but has not the conformation and finish to grade No. 1 or choice. The grade admits fat, whole milk fed dairy calves and indiscriminate breeds, as well as those of the beef type that are slightly deficient in conformation or finish. The carcasses, while well formed and above the average in plumpness, are slightly deficient in breadth and depth across the hips, back and shoulders. The necks are short and moderately plump. The legs also are short but somewhat deficient in flesh as compared to No. 1 or choice, giving the appearance of slightly disproportionate length. The bones are soft and red, and tipped with large and soft pearly white cartilages. The "baby fat" is plentiful in some carcasses and in moderate amounts in others but not deficient to the extent of impairing the quality of the flesh. A thin layer of fat is spread over a portion of the back along the loins and small quantities of fat deposits are present in the muscle seams. The flesh does not differ materially from that of No. 1 or choice veal, being fine grained, firm and of a pinkish brown color.

Veal carcasses in all the classes having the characteristics enumerated in the foregoing are graded No. 2 or Good. The greatest number are in the light and medium weights because such carcasses are from calves that usually have had only milk feed. The heavy weight and split veal carcasses of this grade also usually have been fed on milk up to the time of slaughter but have had access to other feeds such as grass and concentrates, but not in quantities sufficient to change the character of the flesh and finish or fat materially. Naturally, the bones are larger and the flesh has taken on a more reddish color and is slightly coarser than younger veal but not to the extent of affecting the quality.

(d) No. 3 or Medium Veal Grade (Bureau of Agricultural Economics):

Medium veal carcasses include the bulk of veal receipts on the market. Carcasses of this grade usually are inclined to be rangy or angular in conformation. They are relatively long, with moderately long thin necks and shanks, and are narrow across the hips, back and shoulders. They are lacking in plumpness. The flanks and plates are thin and the bones are relatively large in proportion to the amount of flesh. The hips, shoulders and spines are prominent and the rounds are relatively thin and flat with long tapering lines from the hips and flanks to the hock joint. There is a small or moderate amount of "baby fat" around the kidneys, which often are visible, and in the crotch, and there is scarcely any or no fat over the back. Usually in the heavy weight and split veal classes, the fat has lost its appearance of "baby fat," and consists largely of

connective tissues with a moderate amount of soft, pinkish white, or cream colored fat. There is sufficient fat or finish in all carcasses of this grade to make the flesh reasonably firm and suitable for ordinary culinary purposes. The flesh, however, in the heavier weight carcasses of this grade is light red, watery and inclined to darken when exposed for a while to the open air. The grain is also relatively coarse, especially in the heavy weight and split veal classes.

This grade is found in all the classes. Dairy types, mixed breeds and skimmed milk fed and often western calves from drouth stricken regions contribute largely to this grade. The bones of the heavy weight and split veal classes are relatively hard and white and the flesh of the split veal bears a pronounced resemblance to "baby beef," it being redder, coarser and more watery than those in the usual weights of this grade, but possessing a preponderance of veal characteristics sufficient to retain the carcass in the No. 3 or medium grade.

(e) No. 4 or Common Veal Grade (Bureau of Agricultural Economics):

A No. 4 or common veal carcass is the lowest grade of veal regularly offered on the market. The carcasses are angular, thin and lacking in finish. The bones are prominent and the flesh is thin in all parts. Such carcasses are disproportionately long and narrow across the hips, back and shoulders, and the hip and shoulder joints are especially noticeable. They have no fat covering and only traces of fat deposits in the regions of the kidneys and in the crotch. The flesh is coarse grained, stringy, soft and flabby, and often extremely watery.

The outer surfaces darken readily in the open air or when retained for any length of time under refrigeration with the skin off. Carcasses of this grade are found in all weight classifications and are especially unattractive in the heavy weight and split veal classes.

(f) No. 5 or Canner Veal Grade (Bureau of Agricultural Economics):

Under normal conditions No. 5 or canner veal is not offered to the retail trade. It is generally boned and used in the manufacture of sausage, canned meats and delicatessen products. The carcasses are very thin and angular and have no fat over the exterior or interior surfaces. The flesh is soft, flabby, and watery and darkens readily when exposed to the air. Such carcasses usually are from underfed calves of uncertain breeding. The grade is found in limited numbers in all weight classes. The largest percentage, however, is in the heavy and split veal classes.

(g) "No Grade" Veal Grade. (See Methods of Grading).

(5) Army Requirements. The veterinary inspection of carcass veal for the Army should satisfy the sanitary requirements of the Surgeon General and also the requirements of the Quartermaster General if purchased under the latter. Carcasses selected should be those that have been officially inspected and stamped and which have been handled, chilled and stored under proper sanitary conditions.

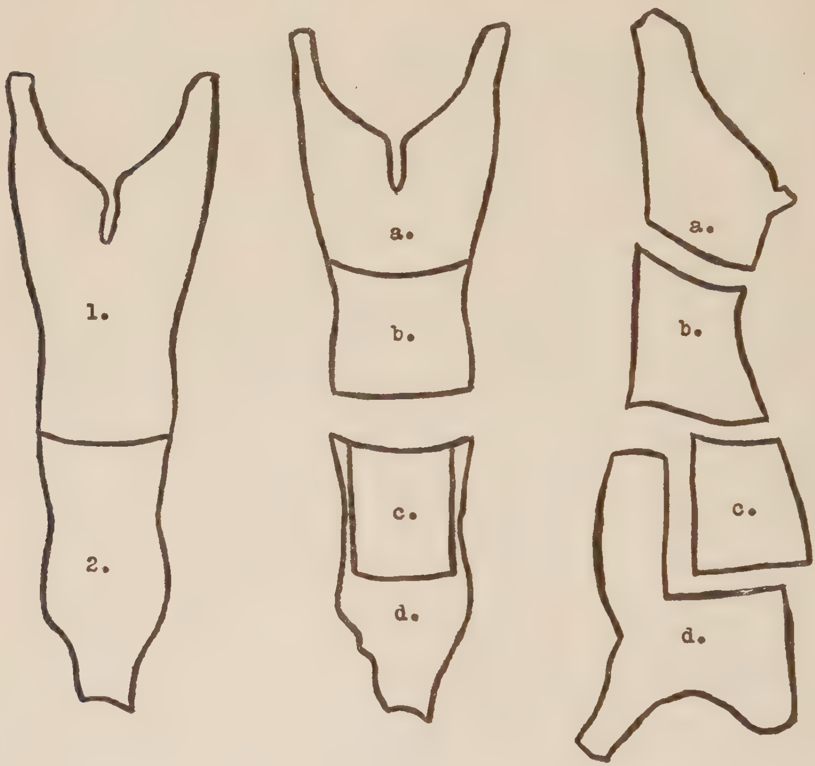
They should be of recently slaughtered animals either chilled or frozen without any signs of storage, age, or of deterioration as appears first under the skirts and on the flank. Veal carcasses should meet the weight requirements of the purchasing authorities. A tentative grading may be given each carcass before the skin is removed, by palpating the back from the rump to the shoulders, the flank and the brisket and by making an interior examination. In this manner carcasses not showing good form, thickness or muscular development, finish and quality should not be considered further. In undernourished, thin calves the back bones and ribs are not well covered, the flanks are thin and soft, the shanks small and long, and there is a general absence of quality. In these carcasses, the prominent spinous processes of the vertebrae may be reduced by means of a mallet prior to selection to improve the appearance. Veterinarians should be careful to consider this point. After chilling and before final grading, the skin and pluck (if present) should be removed. Skinned veal that is smeary, discolored and dry on the outside should be rejected. The grade of a good medium weight veal is desirable. Reference should be made to the current War Department purchase specifications for this selection and for further handling. Attention should be directed particularly to weight, quality and condition. This would include inspection of the quality as shown by the texture, grain, color and appearance of the musculature, the vascularity, softness and size of bones, the firmness and amount of fat, especially around the kidneys, amount of cartilage, etc., as outlined under grades.

Any ragged tissues, the testes and the sweetbread, if present, should be removed and the carcasses split. From a sanitary standpoint wrapping of veal sides usually is desirable. The method and kind of wrapping will be contingent to subsequent handling and shipment. Coverings may be omitted when delivered locally in a clean container. For freezer stock, veal may be wrapped in muslin or stockinette and this covered with durable burlap. For car or wagon transportation a sufficient protective covering should be used to prevent contamination and at the same time these should not be detrimental to preservation. Usually muslin or stockinette bags are used.

If intended for the freezer, chilled veal carcasses should be skinnned and prepared as quickly as possible and frozen without delay, to conserve the moisture and color. Veal freezes very quickly in temperatures below zero. This is due to the comparative thinness of flesh coupled with the high moisture content. After freezing, veal should be placed

in a holding freezer at 10°F. Veal may have a cooler shrink of from 5 to 7 per cent.

c. Wholesale Cuts of Veal. (1) General. (a) Description of Cuts. Veal carcasses sometimes are split into two sides which may be divided



(Dorsal View) (Dorsal View) (Lateral View)

Initial Cuts *Secondary Divisions*

Fig. 20. Standard Wholesale Market Cuts of Veal

1, Hind Saddle; *2*, Forequarters or Rack; *a*, Legs; *b*, Loins; *c*, Hotel Rack; *d*, Chucks or Stews; *ab*; Hind Saddle; *cd*, Forequarters or Rack.

into fore and hind quarters. More often the carcasses are divided (ribbed) between the eleventh and twelfth ribs without being split, forming the fore quarters or rack and hind saddles, each representing about 50 per cent of the carcass weight.

The fore quarters may be divided into the hotel rack corresponding to the two "ribs" of beef and the chucks or stews. The hotel rack is 7 ribs long and is about $16\frac{2}{3}$ per cent of the carcass weight. The chucks include the plates or breasts and are about $33\frac{1}{3}$ per cent of the carcass weight. The forequarters may be cut so as to include 12 or 13 ribs. The Philadelphia cut includes 8 ribs on the forequarters.

The hind saddles may be divided into legs and loins. The legs corresponding to beef rounds are about $33\frac{1}{3}$ per cent of the carcass weight. The loins are about $16\frac{2}{3}$ per cent of the carcass weight.

Other cuts are sometimes made as "bridles" (forequarters and loins), hind quarters and short legs.

(b) Utilization. Cutlets and roasts are made from legs; roasts and chops from the loins and hotel racks; roasts, steaks and chops from the shoulder and thicker part of the neck, and stews from the breast and shanks. Stuffed veal breasts are used for roasts. Hotel racks are the more expensive, then follow loins, legs, chucks and breasts. Saddles are worth nearly two times the value of the forequarters.

(2) Methods of Grading Veal Cuts. The methods of grading, and grades of veal cuts correspond in every particular to the grade of the carcass from which they are derived. Wholesale veal cuts are seldom made from canner carcasses.

(3) Grades of Veal Cuts. (Bureau of Agricultural Economics):

No. 1 or Choice Saddles are plump and well proportioned. They have short stocky shanks, and thick fleshed rounds and loins. The exterior is well and evenly covered with a thin layer of "baby fat," which is white or creamy in color. There are also liberal quantities of fat around the kidneys and they are evenly covered. Moderate quantities of fat are also found in the crotch. The flesh is firm, and has a rich pinkish brown color. The grain of the flesh is smooth and fine.

No. 2 or Good Saddles may be slightly deficient in one or more respects as compared with No. 1 or choice saddles but not to a marked degree. The legs usually are more tapering and not so thick or bulging. Exterior fats are not so evenly distributed but the loins are well covered. Interior fats are plentiful and kidneys are usually well covered. The flesh is firm, fine grained and is pinkish brown in color.

No. 3 or Medium Saddles are markedly deficient in some respects or may be slightly deficient in all as compared with No. 2 or good saddles. There is usually a hollowness on the rounds and they show the results of insufficient nourishment. The loins are only moderately thick and they lack plumpness. The distribution of exterior fats is uneven and it usually appears only in spots. Interior fats are relatively scarce, and there is practically no covering over the kidneys. The flesh is moderately firm and it may be slightly watery, but not to a marked degree. Its color is usually a shade darker than No. 2 or good or No. 1 or choice grades.

No. 4 or Common Saddles have relatively long shanks, comparatively thin flesh and no fat covering. There is also a total lack of interior fats. Loins are flat and thin. The flesh is soft and flabby, relatively dark in color and usually watery to a marked degree.

No. 1 or Choice Forequarters are well proportioned. They have thick, short necks, thick plates and briskets and short blocky shanks. The exterior fats are evenly distributed over the backs and shoulders and there are moderate amounts on the briskets. Its color is white or creamy. The flesh is firm, fine grained, velvety to the touch and is pinkish brown in color.

No. 2 or Good Forequarters may be deficient in some respects or only slightly deficient in all respects as compared to No. 1 or choice forequarters. They usually resemble the No. 1 or choice grade closely in most if not all respects. They usually have lesser amounts of exterior fats over the back and shoulders and it is not so evenly distributed. The flesh is firm, fine grained and pinkish brown in color.

No. 3 or Medium Forequarters are deficient in all respects as compared to No. 2 or good and No. 1 or choice forequarters. They are thin through the back and shoulders, and lack fullness on the necks. Bones are prominent and their location easily discernible. There is usually no fat covering. The flesh is soft and flabby and inclined to be watery and its color is a shade darker than the flesh of No. 2 or good veal.

No. 4 or Common Forequarters are the lowest grade offered for sale to retail dealers. They are thin through the back, shoulders and breasts. The percentage of bone is high. On account of the lack of sufficient flesh the location of all bones is easily discernible to the eye. There are no exterior or interior fats. The flesh is dark colored and usually very watery.

Unsound veal cuts are graded as "No Grade" (see Methods of Grading Carcass Veal).

(4) Army Requirements for Veal Cuts. These in general are the same as for carcass veal. Reference should also be made to the current War Department purchase specifications.

d. Trimmings of Veal. A few canner veal carcasses are cut, boned out, the meat used in sausages and canned meat products and the bones and fats rendered into edible and inedible products.

4. Fresh Mutton. a. Offal. (1) Blood. Sheep blood is dried, ground and used in stock foods and fertilizer. A sheep averages $2\frac{1}{2}$ pounds of liquid blood, from which about $\frac{1}{2}$ pound of dry blood is obtained, depending on the size of the animal and the percentage of moisture in the dried product.

(2) Feet. The feet or "trotters" are made into glue and tankage.

(3) Pelt. Sheep pelts are almost equal in value to the carcass. They are sold with the fleece on for coat linings or for other purposes. Most of them are sent to wool pulleries where they are washed clean, dried centrifugally, treated on the flesh side two to twelve hours with

a depilatory solution of lime and sodium sulfide, after which the wool is pulled by hand. The skins are again treated with milk of lime for three to six days. This depilates the tag ends of wool, dissolves out the grease in the form of calcium soaps and firms up the pelts. The skins or "slats" are delimed, pickled one to two days in strong brine plus a small amount of sulfuric, formic or acetic acid, removed from pickle, graded according to quality, size and condition, and used in the manufacture of leather goods. The wool which is pulled is sorted as back, belly, shank and face wools, graded according to staple, length, texture and color; dried in warm air chambers; baled by hydraulic pressure into bales of about 300 pounds each and sent to scouring establishments where it is scoured, graded and sold as pulled wool. The grease from scouring is used in inedible tallow and soap manufacture. Adeps lanae (wool fat without water) and Lanolin (hydrous wool fat) also are made from the purified grease.

(4) Head. A few heads are cleaned and sold whole but as a rule they are divided into the tongue, meat trimmings, brain and bones.

The tongue is removed, washed, inspected, trimmed, chilled and sold fresh, cured, cooked, jellied, canned or made into sausage, or potted meats. Tongue trimmings are made into second grade tallow.

The cheek and head meat is removed, inspected, chilled on trays or frozen, and sold fresh, made into sausage or canned.

The brain is removed, inspected, chilled or frozen and sometimes canned. The pineal and pituitary bodies are sometimes saved for the pharmaceutical trade.

The head and jaw bones are made into inedible tallow, glue, steam bone or poultry food.

(5) Genito-Urinary Organs. With the exception of the kidneys, these organs are classed as inedible and usually are made into inedible tallow and tankage. Some ovaries, testes, mammae and prostates are saved for the pharmaceutical trade. Commercially, testes of lambs are saved, chilled or frozen and sold as fries. The kidneys usually accompany the carcass.

(6) Abdominal Viscera. The visceral products are disposed of according to commercial demand. They are made into prepared products or otherwise converted into tallow, grease or tankage.

The small intestines, caul fat and liver are practically all of the abdominal viscera used, the remainder usually going for tankage.

The small intestines are pulled, being removed from their attachments with a knife and stripped by hand. All pieces under 6 feet are

tanked. They are used for high grade sausage casings, surgical ligatures, violin gut strings or tanked. For casings they are handled much the same as hog casings. Care is exercised throughout as they are very susceptible to breakage. Their small calibre makes turning impracticable. The period of fermentation is from four to six hours. They are graded as wide, medium, and narrow. "Wides" are $\frac{15}{16}$ of an inch or more in width; "mediums," $\frac{12}{16}$ to $\frac{15}{16}$ of an inch; and "narrows," $\frac{12}{16}$ of an inch and under. After being measured, they are put up in "hanks" or bundles; wides 90 yards long; mediums, 120 yards long; and narrows 130 yards long. These bundles are cured one week in coarse salt, the salt shaken out, fine salt added and then packed tightly in barrels. About 60 per cent of salt is present in wide casings and 50 per cent in medium and narrow casings. The narrow casings are used only to a limited extent as sausage casings, the bulk being converted into surgical ligatures.

Large intestines are usually tanked. Clean white guts and bung ends may be used in second grade tallow. A few cecums are saved, washed, slimed, cured and sold as "fish skins" or casings for the prevention of human venereal diseases. Caul fats free from animal parasites, disease and contaminations, may be used as an outside dressing for the carcass, for tallow, oleo oil, glycerine or for Alaskan dog food, otherwise they are tanked. Ruffle fats are used for edible purposes or are tanked.

The stomachs usually are hashed, cleaned and made into prime tallow or tankage. The rumen and reticulum are sometimes made into sheep tripe and sold as such or used in sausage.

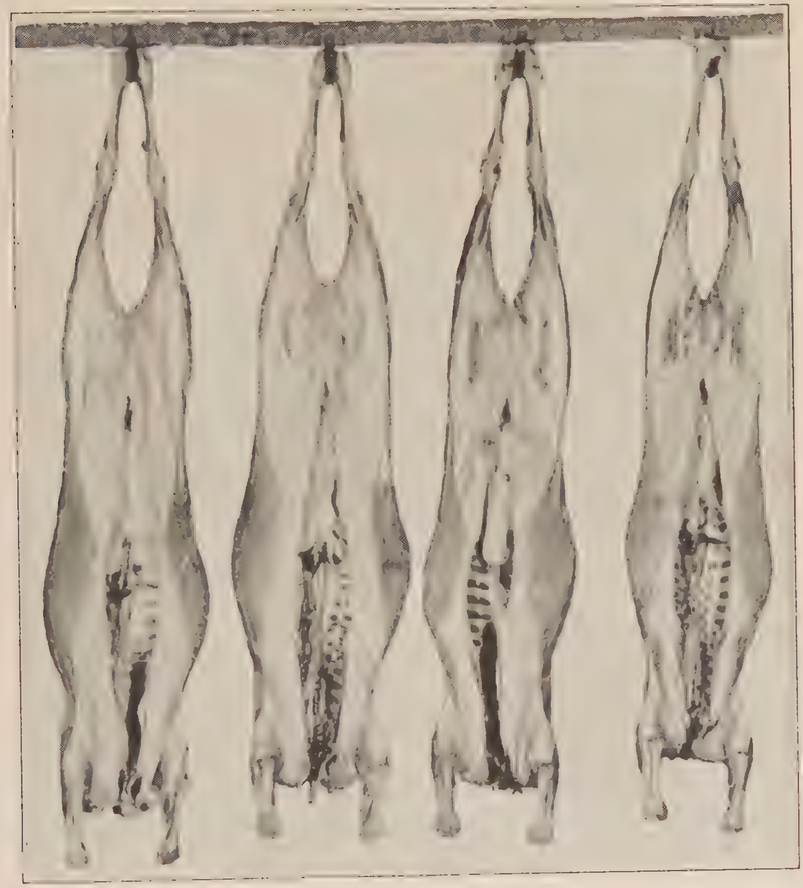
The pancreas is saved for the pharmaceutical trade or rendered into second grade tallow.

The spleen or melt is considered inedible. Commercially it may remain attached inside the carcass and sold, or removed and rendered into tallow.

Livers are of low value, being highly parasitized. They may remain in the carcass, sold fresh or frozen with the pluck; or separated, trimmed free from the gall bladder and other extraneous tissues, washed, chilled on trays and sold fresh or made into sausage. If held for more than four days, they are frozen. For export they are frozen and packed in boxes. If not used for food they are tanked. Livers rejected for animal parasites not transmissible to man, may be cooked by the establishment and used as chicken food. Gall bladders are tanked as inedible.

Fecal pellets sometimes are saved for hot house fertilizer.

(7) Thoracic Viscera. The pluck, consisting of the heart, lungs trachea, oesophagus, thyroid glands, "heart" sweetbread, liver and



(*Permission United States Bureau of Agricultural Economics*)

Choice Good Medium Common

(Ventral view)

FIG. 21. CARCASS LAMB

attached tissues, remains in 35 per cent of the carcasses of lambs. It may be removed entire, trimmed, inspected, chilled and sold fresh, or frozen in rosette form on trays, and packed in boxes for export. Otherwise, plucks are divided into various parts.

The lungs, trachea, oesophagus, heart sweetbread and trimmings go into second grade tallow or fertilizer.

The thyroids are sometimes used for the pharmaceutical trade.

The hearts are washed, chilled on trays, sold fresh, put into sausage or frozen for export.

(8) Miscellaneous. The cervical portion of the thymus gland may be sold fresh or frozen.

The thymus, suprarenal bodies and lymph nodes are sometimes saved for the pharmaceutical trade.

Carcass dressing fats are sent to the oleo department, or tanked with inedible scraps and floor scrapings.

b. Carcass Mutton. (1) General. The different styles of dressing ovine carcasses have been discussed under Sheep Slaughter. Practically all sheep carcasses are marketed fresh and disposed of within ten to fourteen days after slaughter. Some of the better grades are frozen especially between November and March, while thin carcasses are seldom frozen because of the rapid deterioration attending subsequent defrosting.

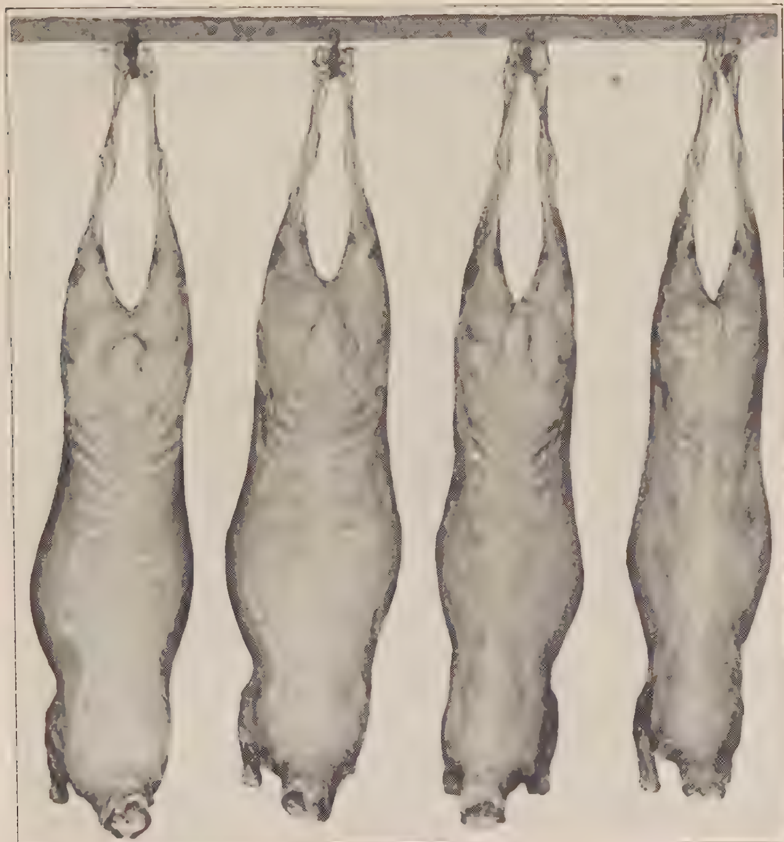
(2) Classes. The main classes of ovine carcasses are lambs, yearlings and mutton. These classes are based on age and are distinguished by differences in size, weight, conformation, quality and other characteristics. Weight and size are not always indications of age, but may be indicative of care, feed and breed.

(a) Lambs. Seventy-five per cent of ovines are marketed as lambs, nine to fifteen months old. Carcasses weigh 30 to 50 pounds and are distinguished by the plump, smooth conformation; smooth, moist, red, dentated break joints of the fore legs; soft, red bones; dull pink ribs; the relatively thin, slightly pinkish-cream outer covering of fat; white, brittle internal fat, and the light colored flesh. No sex distinction is made. Special sub-classes of lambs include *Spring Lambs* and *Hothouse Lambs.*

Spring Lambs refers to very young ovines of three to four months of age, weighing 20 to 30 pounds. *Genuine Spring Lambs* or *Milk Lambs* refer to the first offerings of the season from May 1 to July 4. They have uniformly light, tender flesh. After July 4, and practically at all seasons of the year, light weight, grain fed carcasses of good quality are quoted as Spring Lamb.

Winter, Hothouse or Incubator Lambs are Fall Lambs, produced under cover away from climatic conditions and marketed from January to March weighing at that time, 20 to 45 pounds gross.

(b) Yearlings. About 20 per cent of ovine carcasses are sold as yearlings especially from March to May. They are in an intermediate class, being too old, mature and heavy to be classed as lambs and have



(Permission United States Bureau of Agricultural Economics)

Choice Good Medium Common

(Dorsal view)

FIG. 22. CARCASS LAMB

not the general development or characteristics of mutton. Sex does not influence although 90 per cent are wethers. They weigh 40 to 60 pounds dressed and frequently are sold as lambs. Compared to

lambs, yearlings have a longer body and legs, a larger abdominal cavity; coarser meat which is dark pink to light red in color; harder bones although some red color still remains; the break joint is comparatively hard, rough, porous and dry with slight indication of blood, and the fats usually lack the white creamy effect of lambs.

(c) Mutton. About 5 per cent of ovine carcasses are sold as mutton especially during late summer and early fall, being distinguished from lambs and yearlings by their greater size and maturity. Mutton carcasses are about 50 per cent heavier than lambs and 25 per cent heavier than yearlings and have relatively heavy forequarters and light hind quarters. The ribs are more bowed than in yearlings giving them a barrel-shape appearance; the bones are larger, whiter and flinty; round joints are present instead of breakjoints on the fore legs; the flesh is deeper red and the outer and kidney fats are greater in amount and darker in color, sometimes with a tinge of yellow. Sex is a factor and mutton carcasses are distinguished as ewes, bucks and wethers.

Ewe Carcasses. The bulk of mutton is produced from mature female sheep or ewes which may or may not have borne young. They are less desirable than wethers. They are characterized by an angular, rimmy, slender appearance being less smooth than yearlings, long thin necks, slender shanks, prominent hip bones, legs relatively not full or plump; flesh fine to coarse grained, dull red and not well developed or abundant over the ribs, back and loin; bung or vent, large, and the milk bag or udder present or indications of its removal.

Buck Carcasses. Bucks or rams are uncastrated male sheep which have been used for breeding purposes. Those castrated after the development of the male sex characteristics are termed, "Stags." Carcasses of bucks and stags are relatively scarce, less desirable than wether carcasses and are usually sold as wholesale cuts rather than in the carcass. They are characterized by a large, massive appearance, bulging rather than smooth; the necks, short and thick; the breasts and shoulders thick, having a strong muscular development; the hind-quarters relatively small in proportion to the forequarters; the bones large; the flesh dark or dull red, coarse grained, strongly developed and sometimes having a disagreeable odor; a thick, oily fell; yellowish fat, thick and wasty over the carcass and small in amount in the interior; bung or vent is small; open inguinal rings, and the cod fat is sometimes absent.

Wether Carcasses. Wethers are mature male sheep which were castrated at an early age. Wether carcasses are rarely found and are more desirable than ewes, bucks or stags. They are characterized by a well-proportioned shape; regular, even conformation; smooth, rounded, compact form; neck full and short; hindquarters relatively larger than forequarters; fat evenly distributed and not wasty; high percentage of thick, dull red flesh of a fine texture; small vent and the presence of cod fat.

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Good Medium Common — Ventral view; Good Medium Common — Dorsal view

FIG. 23. YEARLING-CARCASS MUTTON

(3) Methods of Grading Lamb, Yearling and Mutton Carcasses. These carcasses are graded out according to form, thickness, finish, quality, weight and soundness much the same as beef carcasses. Weight is very important. Lamb carcasses are graded as No. 1-A or Prime; No. 1 or Choice; No. 2 or Good; No. 3 or Medium; No. 4 or Common; and No. 5 or Culls. Yearlings are graded as No. 1 or Choice; No. 2 or Good; No. 3 or Medium; No. 4 or Common; and No. 5

or Culls. Mutton grades have the same designation as those for yearlings. "No Grade" carcasses are those of lambs, yearlings or mutton which have not passed a satisfactory recognized veterinary examination in accordance with Army Regulations, those not bearing the inspection legend of an authorized sanitary inspection agency, or which have not been properly stored or handled subsequent to inspection, and those unsound, unwholesome or unfit for human consumption in any manner. The first grade in each class represents carcasses having the most desirable points under form, thickness, finish, quality and weight. Culls are quite deficient in all respects while for intermediate grades, intermediate qualities exist.

(4) Grades of Carcasses. (a) Lamb Carcasses. (See Figs. 21 and 22.)

No. 1-A or Prime Lamb Carcasses (Bureau of Agricultural Economics):

Carcasses of this grade are ideal in all respects. Splendid conformation, small and soft bones tinged with red, clear white fat and smooth, fine grained, light pink flesh are all essentials which must be found in the carcass to place it in the prime grade. The outer covering of fat is smooth and evenly distributed over the carcass and is interspersed with strips of pink flesh over the sides, covering the breasts and flanks and extending well up to but not over the back bone. The flesh is firm in all parts and has a smoothness similar to that of velvet. Even the best finished carcasses seldom have excessive interior fats and this feature is only a minor element in the consideration of grades.

No. 1 or Choice Lamb Carcasses (Bureau of Agricultural Economics):

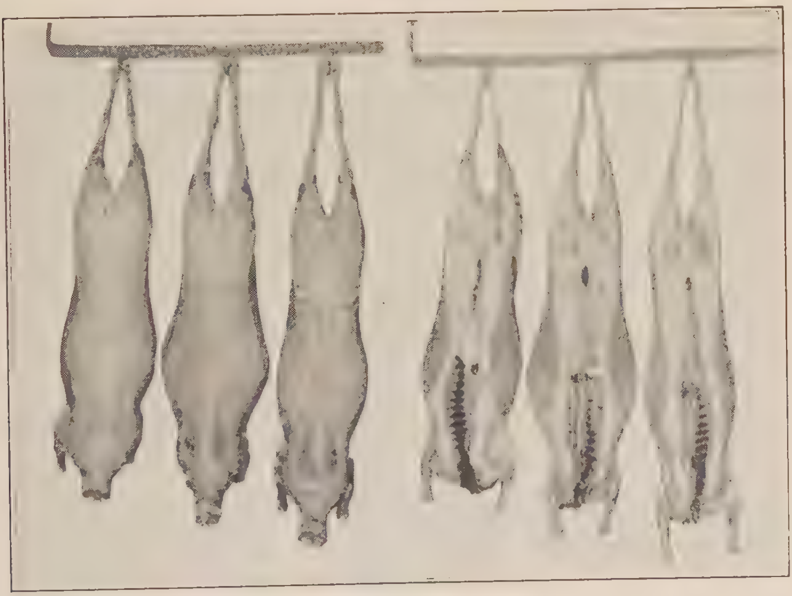
Carcasses of this grade are relatively short, thick and compact. They have short stocky legs, thick loins and backs, and well proportioned shoulders and breasts. Long barreled carcasses, although fleshy and well covered, are not graded choice as they resemble yearlings in appearance. Bones are soft and red with blood, both indicating a young animal. The kidneys are well and evenly covered with white brittle fat. A low percentage of kidney fat indicates a low grade carcass. The flesh is of a light pink color, fine grained and smooth. The ridges of the break joint are smooth and moist and covered with blood. Carcasses of this grade which are in most demand, weigh from 32 to 45 pounds with the bulk between 35 and 40 pounds.

No. 2 or Good Lamb Carcasses (Bureau of Agricultural Economics):

No. 2 or good carcasses may be slightly deficient in one or more respects as compared to choice but not excessively so. There may be slight indications of paunchiness or a slight tendency toward the range type indicated by longer shanks and a longer body. Legs and back are moderately thick and have a degree of plumpness. Bones are soft and red. The covering of fat is smooth and regular and the flesh is firm, fine grained and light pink in color. No. 2 or good lambs seldom weigh more than 55 lbs. and the bulk weigh between 35 and 50 pounds.

No. 3 or Medium Lamb Carcasses (Bureau of Agricultural Economics):

No. 3 or medium carcasses are usually angular or rangy in conformation and resemble yearlings in many respects. They have long tapering legs, relatively long necks and are comparatively thin fleshed. They are especially thin through the ribs. The outer covering of fat is scant and is not evenly distributed. Interior fats are also lacking in the lighter carcasses, but may be excessive in the heavier carcasses or those which approach the yearling type. All fats are slightly darker or more creamy than those of better grade lambs. The flesh is inclined to be soft and shows a lack of sufficient nourishment, or may be firm in heavier



(Permission United States Bureau of Agricultural Economics)

Good Medium Common Good Medium Common

Dorsal view Ventral view

FIG. 24. CARCASS MUTTON

and older carcasses, but have a comparatively coarse grain. Its color varies slightly from light to dark pink. There is a wider range of carcass weights in the medium grade than any other which includes comparatively thin fleshed carcasses of young lambs, and those close to the yearling class which often are excessively heavy. Weights range from 30 to 60 pounds with the bulk between 35 and 50 pounds.

No. 4 or Common Lamb Carcasses (Bureau of Agricultural Economics):

The principal feature which distinguishes a common lamb carcasses from other grades is a marked lack of flesh. Bones are very prominent. The contour of the back bone is usually plainly visible from the neck to the rump. Sides are thin, flanks thin and flabby, and dark in color. There is little or no outer covering of fat and practically no interior fats in the lighter carcasses. Heavier carcasses which are from older lambs frequently have a small percentage of kidney fat and its color resembles old skimmed milk. Bones are usually soft but they lack the redness of those in carcasses of well nourished lambs. Carcass weights range from 25 to 40 pounds with the bulk between 25 and 35 pounds.

No. 5 or Cull Lamb Carcasses (Bureau of Agricultural Economics):

Carcasses of this grade are not offered regularly for retail trade and only occasionally are such carcasses found in the markets. The percentage of flesh to bone is exceedingly low, and all bones are very prominent. Carcasses are entirely devoid of fat and are of the most inferior form and quality. The flesh is dark in color, comparatively coarse and very watery. There is a limited demand for cull lamb carcasses from certain foreign born residents in the larger cities, who prefer lean flesh without any fat. Cull lamb carcasses are used principally for canning. Weights range from 15 to 25 pounds.

"No Grade" Carcasses. (See Methods of Grading.)

(b) Yearling Carcasses. (See Fig. 23.)

No. 1 or Choice Yearling Carcasses (Bureau of Agricultural Economics):

Choice carcasses are smooth and well covered and have good conformation. They resemble No. 1 or choice lamb carcasses in many respects, but have proportionately longer bodies, legs and necks, also larger abdominal cavities and more distended ribs. They are well covered with fat and have thick, full, and well rounded loins and ribs. There is usually more kidney fat than in choice lamb. The flesh is firm and moderately fine grained but lacks the juiciness of choice lamb, and is always darker in color. The percentage of yearlings which grade choice are almost negligible and such carcasses are not usually sold as lambs. Weights range from 45 to 60 pounds.

No. 2 or Good Yearling Carcasses (Bureau of Agricultural Economics):

Good yearling carcasses are markedly deficient in some respects or slightly deficient in all as compared to choice carcasses. The conformation is usually less regular, having wide abdominal cavities and more distended ribs. Compared with No. 2 or good lamb carcasses they are from 20 to 30 per cent heavier and have proportionately greater length, and lack the thick blocky legs and loins. The bones of good yearling carcasses usually have a marked degree of redness, but are rough and porous. The redness decreases as the mutton stage is ap-

proached, while the roughness and hardness increases. Carcasses of this grade have more exterior and interior fats than good lamb and it is harder and more brittle. The thin strips of lean on the flanks and sides of the carcass are plainly visible through the "fell" and these are darker in color; often dark red as compared to light pink in lambs. The flesh is firm, moderately fine grained and the color varies from light to medium red according to the age of the animal. Carcasses of older animals of the ovine class always have darker flesh. Weights range from 45 to 65 pounds.

No. 3 or Medium Yearling Carcasses (Bureau of Agricultural Economics):

Carcasses of the No. 3 or medium grade are deficient in finish as compared to the good grade and the conformation is uneven. A lack of fullness or thickness in the principal primal parts gives the carcass a rangy or angular appearance. Legs are long and tapering; loins thin; ribs thin and bulging, and breasts thin. There is usually only a thin covering of fat over the shoulders and moderate amounts on the loins. Interior fats are scarce, limited amounts usually are found in the region of the kidney but the kidneys are rarely covered. While the flesh is comparatively fine grained, it is usually moist, and light to dark red in color. Carcass weights range from 40 to 65 pounds. A large percentage of medium weight mutton is frequently sold as medium grade yearlings. When this is done the end of the front shank is "chopped off" and such carcasses are then referred to in the trade as "choppers."

No. 4 or Common Yearling Carcasses (Bureau of Agricultural Economics):

This is the lowest grade which is offered regularly for sale to the retail trade. The features which distinguish the grade principally are the marked lack of flesh and finish and the high percentage of bone. Common carcasses have no interior fats and usually no exterior fats except on the shoulders and along the back and loins. They have thin tapering legs and thin, flat loins and ribs. Retail cuts from carcasses of this grade make undesirable roasts and chops and they are sold principally to a cheap class of trade. Weights range from 30 to 55 pounds.

No. 5 or Cull Yearling Carcasses (Bureau of Agricultural Economics):

Carcasses of this grade are all that the term "cull" implies, and are from undernourished animals. The percentage of bone to meat is unusually high. They are entirely devoid of fat. The flesh is dark in color, coarse and stringy. Weights are usually between 25 and 35 pounds. They are not offered regularly at retail, and therefore do not appear on the markets generally. Aside from a limited demand from foreign born residents in the larger cities, there is practically none sold to retail fresh meat trade. The bulk is boned at the packing houses and used for canning.

"No Grade" Yearling Carcasses. (See Methods of Grading.)

(c) Mutton Carcasses. (See Fig. 24.)

No. 1 or Choice Mutton Carcasses (Bureau of Agricultural Economics):

Mutton carcasses of this grade resemble No. 1 or choice yearlings in most respects, but have harder bones and darker colored flesh. There is also the difference in the break joint of the fore leg to which reference has already been made. No. 1 or choice carcasses are well proportioned and regular in conformation. They have comparatively short, stocky legs, thick loins and full fleshy shoulders, and thick breasts. Such carcasses have good breadth in proportion to length and are not rangy or angular. The outer covering of fat is smooth and evenly distributed, having the greatest depth over the rumps, loins and back but not excessive at any point. The kidneys are well covered with a smooth creamy fat inclining to a yellowish tinge. The outer covering of fat is also creamy. The strips of lean on the sides and breasts are prominent, and these are dark red in color. The flesh is firm, moderately fine grained and dark red in color. Carcass weights usually range from 60 to 80 pounds.

No. 2 or Good Mutton Carcasses (Bureau of Agricultural Economics):

Carcasses of the No. 2 or good grade consists almost entirely of ewes. They are less regular in conformation than those grading choice and have wider barrels and more distended ribs. This, however, does not apply to wether carcasses, a small percentage of which are usually found in this grade. The outer covering of fat while fairly even, varies to some extent and may be slightly excessive on the rumps or deficient on the shoulders and flanks. The percentage of carcasses from old ewes in this grade is higher than any other grade, and the bones as a rule are harder and cannot be easily cut. The flesh is firm, but coarse and dark. The strips of lean flesh on the sides are less prominent than on choice carcasses, but are well defined. Extreme weights are wide and range from 60 to 150 pounds, with a few ranging up to 200 pounds. The bulk, however, are between 65 and 90 pounds.

No. 3 or Medium Mutton Carcasses (Bureau of Agricultural Economics):

Carcasses of this grade are deficient in finish as compared to good mutton. On account of a lack of fullness or plumpness in legs, loins, and ribs, the carcasses appear long and angular. The abdominal cavity is wide and the curvature of the ribs is very marked. Carcasses are proportionately thin and narrow through the loins, but wide and full through the shoulders. There is usually very little fat covering, except on the back and a thin coating over the loins and rumps. Interior fats are lacking. Slight traces may be found around the kidneys. The thin strips of lean meat, which are so prominent, on the sides of good and choice carcasses are not usually found on medium carcasses. The flesh is soft, coarse grained and frequently moist or watery. It is usually dark in color and lacks the redness of the better grades. Carcass weights range from 45 to 90 pounds with the bulk between 50 and 60 pounds.

No. 4 or Common Mutton Carcasses (Bureau of Agricultural Economics):

Only a small percentage of the offerings of mutton, grade as low as No. 4 or common. The grade consists principally of carcasses from old and worn out ewes. They lack finish in all respects and the conformation is uneven. Hindquarters are long and thin, forequarters are broad and breasts thin and "shelly." Bones are hard and flinty. The percentage of flesh to bone is very low. There is a total lack of exterior and interior fat, and carcasses usually have a bluish appearance. The flesh is soft and flabby, coarse grained and tough. Its color is dark and unattractive. Carcass weights range from 30 to 60 pounds.

No. 5 or Cull Mutton Carcasses (Bureau of Agricultural Economics):

Carcasses of this grade are not usually found on any of the markets and are therefore not a factor in the dressed meat trade. They are used principally for canning and seldom are shipped in the carcass from packing plants. Such carcasses are what the term implies. They are undesirable for sale as fresh meat. The flesh is very unattractive, it is soft, flabby, watery and very dark in color. Carcasses are entirely devoid of fat and lack sufficient flesh to make suitable chops or roasts. A large percentage of carcasses in this grade are so thin in flesh as to be almost transparent through the sides and ribs. They are as a rule boned and used for canning. Carcass weights range from 25 to 50 pounds.

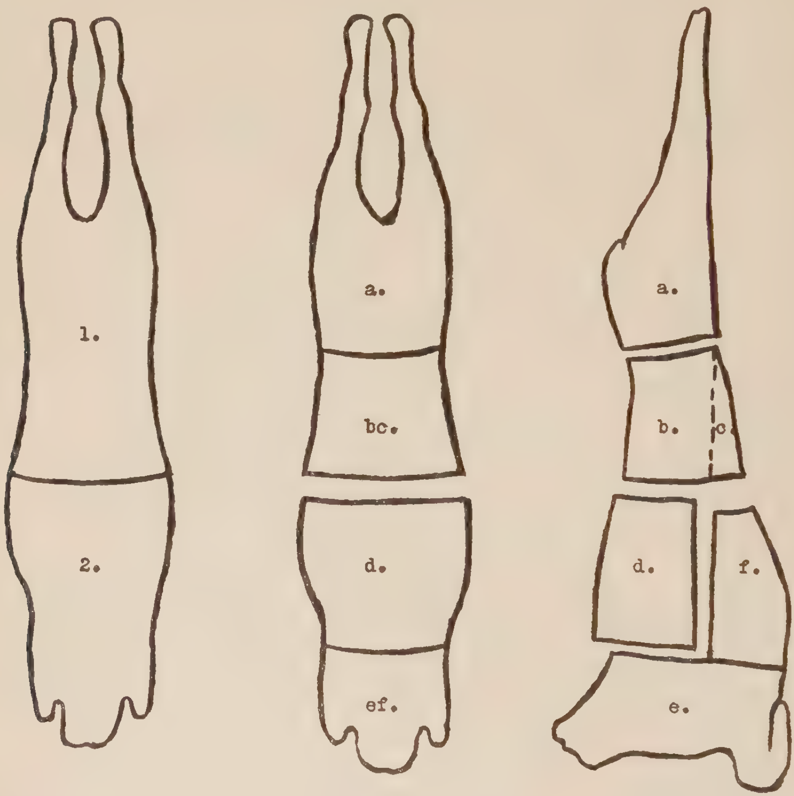
"No Grade" Mutton Carcasses. (See Methods of Grading.)

(5) Army Requirements. These include the sanitary requirements of the Surgeon General covering the sanitary veterinary inspection of the product, establishments, branding, handling, storage, shipment and reinspections as outlined in Army Regulations; also, if purchased under the Quartermaster General, the War Department purchase specifications as to class, grade, sex, condition, style of dressing, trimming, wrapping, handling, storage, marking, etc.

The veterinarian should guard against selecting goat carcasses. The characteristics of a goat carcass are as follows: angular appearance; back and withers sharply pointed; croup sloping; bones quite brittle; shanks long and slender; the fore arm (radius or shank) is two times the length of the shin (large metacarpal bone) while in sheep it is $1\frac{1}{4}$ times as long; long, thin necks; flattened thorax; darker, coarser flesh, sometimes with characteristic goat odor; small vent; lack of tail development; knicking of the fell; goat hairs sometimes sticking to fell; outer fat small in quantity and unevenly distributed, and, excessive kidney fat.

In the selection of lamb, yearling and mutton carcasses, age is considered. Age may be verified at slaughter by observing the develop-

ment of the teeth. It is safe to say that the eruption of the permanent first incisors indicates one year of age; the permanent second incisors, two years, and of the permanent third incisors, three years. Older



(Dorsal View) (Dorsal View) (Lateral View)

Initial Cuts *Secondary Divisions*

FIG. 25. STANDARD WHOLESALE MARKET CUTS OF MUTTON

(Adapted from Hall)

1, Saddle *2*, Forequarters or Rack; *a*, Legs; *bc*, Loin; *b*, Loin; *c*, Flanks; *d*, Hotel or Short Rack; *ef*, Rattle, Stew or Slug; *e*, Chuck; *f*, Breast; *abc*, Saddle; *def*, Forequarters or Rack.

mutton carcasses are not desirable. Age is also indicated by soft, red bones, break joint; thick, soft cartilages and light colored, fine fibred musculature in young carcasses and hard, flint-like bones, white in

color; round joint of the fore legs; thin, hard cartilages and dark, coarser musculature in older carcasses. Lambs should be strictly fresh, of good marketable quality, and having a fine grained pink flesh, light weight and other desirable characteristics. Yearlings are more plentiful than mutton carcasses. Wethers are scarce and frequently difficult to obtain. Old ewes are frequently thin as a result of disease or parasitosis, and good grade carcasses are not always available.

Ovine carcasses should be strictly fresh, free from staleness, bruises or other unsoundness (see "No Grade" under Methods of Grading), and properly chilled or frozen as desired. The desirable weights for lamb carcasses are 30 to 45 pounds, and for yearling and mutton carcasses, 45 to 65 pounds. If purchased under the Quartermaster General, the weights as specified govern and carcasses should not be over or underweight but should approximate the average, if stated. A carcass should be of good grade or better, but not wasty. It should be bright in appearance, flesh dull red but not dark; bones of good quality, and should have a moderate amount of good, firm, white fat, properly proportioned and evenly distributed. The fat should not be wasty or gobby as is frequently found in old ewes where it is excessive around the kidneys, rump and brisket. Fat-tailed Persian sheep carcasses should also be avoided.

Caul or plain dressed sheep carcasses with the pluck and spleen out, head off and shanks removed at the hocks and knees (except for lamb) and spread sticks removed after chilling, are desirable. Caul fat, pelts and these other parts cannot well be utilized in the Army. War Department purchase specifications should be followed in inspection for purchase under the Quartermaster General, covering also the wrapping, handling and storage. Both the brands required by Army Regulations and the War Department Specifications should be employed. Also see Storage of Fresh Meats, in this chapter.

c. Wholesale Cuts of Mutton. (1) General. About 10 per cent of ovine carcasses are sold as wholesale cuts. Lamb and yearling cuts are more desirable because of palatability, quality, and relative small size of cuts.

(2) Description of Cuts. (a) General. Carcasses may be divided between the 12th and 13th ribs into saddles and forequarters, or split medially into two sides. Other cuts and subdivisions are also made.

(b) Saddles. A saddle, consisting of the two hind legs, two loins and the last pair of ribs, is about 49 per cent of the carcass weight. It may be subdivided at the hip-bone into legs and loins.

The *legs* include both hind legs and represent one-third of the carcass weight and two-thirds of the weight of the saddle. Legs are utilized principally as roasts, however, retail cuts as chops, steaks and boiling meat are sometimes made.

The *loin* extending from the rump to the 13th pair of ribs inclusive, represents 17 per cent of the carcass weight or one-third of the weight

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Rattle Short rack Loin Legs

FIG. 26. CHOICE WHOLESALE CUTS OF LAMB

of the saddle. Both loins minus the flanks are also known as the loin, being used for loin or kidney chops and loin roast, and the flanks for stews.

(c) Forequarters or the rack, consisting of the two forequarters, is about 51 per cent of the carcass weight. The rack may be sub-divided into a hotel rack and a rattle.

The *hotel* or *short rack* is the thick part of the back from the 3rd to the 12th pair of ribs, inclusive, separated from the shoulder and breast.

It is two-fifths of the weight of the rack and equal to about 12 per cent of the carcass. Rib chops, French chops, and crown roasts are made from hotel racks.

The *rattle, stew* or *slug* includes the two shoulders, two shanks, neck and two breasts. It represents three-fifths of the weight of the rack or 38 per cent of the carcass. It may be sub-divided into the chuck and breast. The latter corresponds to the navel end of beef. Shoulders are used for roasts, chops, stews and boiling meat; the breast and shanks for stews.

(d) Miscellaneous. The short rack, legs, loin and stew are valued in the order named.

Other cuts sometimes made are the long saddle, body and back. The *long saddle* consists of the saddle and short rack in one piece. It represents 63 to 67 per cent of the carcass weight. The *body* consists of the forequarters and loin in one piece. It is about 68 to 70 per cent of the carcass weight. The *back* or *long rack* is the loin and short rack in one piece, representing about 32 to 36 per cent of the carcass weight.

(3) Grades. Wholesale cuts of mutton are graded according to the grade of carcass from which they are derived. Class is also considered. Lamb cuts show a fine grained, light pink flesh; soft, red bones and other lamb characteristics (see Classes). Yearling cuts show whiter bones, and flesh with a moderately fine grain and almost red color. Mutton cuts have hard, flinty, white bones; coarse grained, dark colored flesh and more fat.

(4) Army Requirements. (See Carcass Mutton.)

d. Trimmings. Very few lamb or mutton carcasses are cut or boned. A small amount of mutton is canned as such or it may be used in potted meats. Shop fats and kidneys are rendered into oleo oil or tanked.

5. Fresh Pork. a. Offal. (1) General. Swine offal as covered in this section will include killing room offal from food carcasses. Cutting room offal will be discussed under "Pork Cuts" and "Trimmings." Offal from rejected carcasses is handled elsewhere.

(2) Blood. Blood from swine is dried, ground and used for stock food and fertilizer. The fluid blood from a hog averages $4\frac{3}{4}$ to $9\frac{1}{4}$ pounds from which $\frac{3}{4}$ to $1\frac{1}{4}$ pounds of dried blood may be obtained according to the size of the animal and the percentage of moisture in the finished product. Blood is frequently collected at slaughter of hyper-immune and "virus" swine for the production of anti-hog cholera serum and hog cholera virus respectively.

(3) Hair. The yield of hog hair averages 0.75 per cent of the live weight. The hair after removal from the animal should be sent to the "Inedible" hair compartment as soon as practicable. The handling of the hair and the rooms employed, should be sanitary and the hair dryer frequently deodorized with hydrochloric acid.

The open air curing of hair as practiced by some small abattoirs is not sanitary. The hair is spread in a thin layer in the open, where

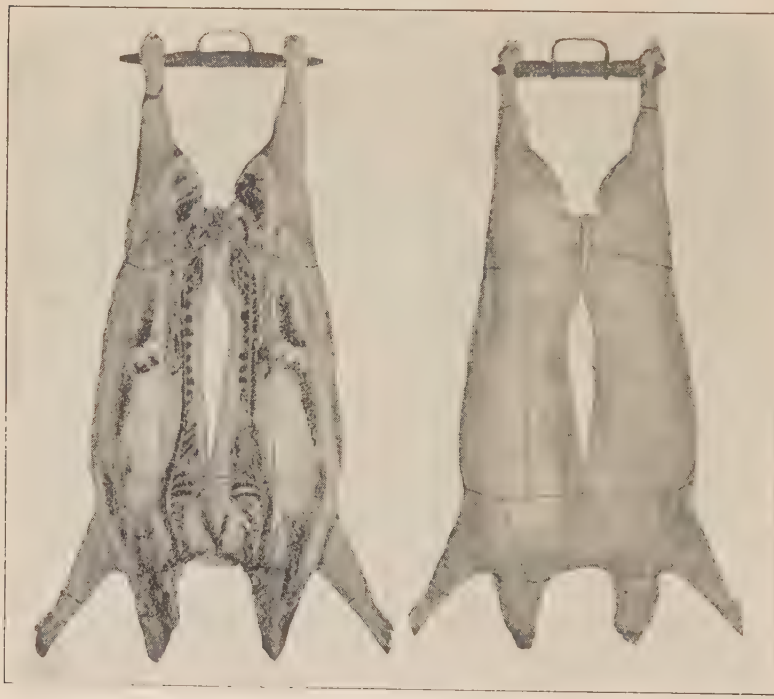

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Fig. 27. Packing Hog Carcass

(Outlining domestic cuts)

during several weeks, disintegration of organic debris as scurf and animal tissue is accomplished through bacterial action. At the same time the product is dried by the action of the wind and the sun's rays.

The small packer may wash the hair, dry in a hair dryer, bale and sell to hair and bristle factories where it is curled and put to other purposes.

Upon coming from the scraping table or machine, the hair is cooled one to two days in a vat of cold water. Three to eight ounces of lye are added to each 325 gallons of water, agitated and heated by steam to the boiling point where it is kept for ten to twelve hours or until the scurf slips easily from the hair. The hair is put through a hair-picking machine two or three times where the hair is picked apart while boiling water and steam wash away the scurf and other animal debris. The clean hair goes to the hair dryer which is heated by means of steam coils or a hot air current. The hair is then pressed into bales. Hair is curled by being twisted into ropes of various sizes. Small ropes may be utilized as such. Large ropes are picked apart for curled hair which is used in upholstering, frequently being mixed with long horse or cattle hair. The heavier bristles may be saved, dyed and used in brush manufacture. Hair screenings are used in making mortar.

When not saved, hog hair may be cooked and mixed with tankage.

(4) Toes and Dew-claws. These skin appendages have no commercial value and are made into white grease, glue or fertilizer.

(5) Head. (a) General. The head may be a market or a regular cut head. Market cut heads have the jowls on, being sold whole without the removal of the teeth, ethmoid or turbinated bones. They must be thoroughly shaved, washed and cleaned free from all hair, scurf or other objectionable material. The regular cut heads have the jowls removed.

(b) Tongue. The tongue is removed on the killing floor, cleaned and trimmed free of tonsils and ragged tissues. The tongue is then given a thorough veterinary examination. This includes inspection of the mucosa of the dorsum for the presence of thread worms. These parasites belong to the genus Gongylonema and are very similar to the Gongylonema scutatum, the common worm of the oesophagus of sheep and cattle. The larvae, after hatching from the ova, penetrate the body cavity of the dung beetle where they develop in a few weeks to the infective stage. These worms are frequent in tongues of southern swine.

Device For Discovering Gongylonema in Hog Tongues

(United States Bureau of Animal Industry Publication)

The device in question consists of a wooden skewer into the end of which trimmed down to a short conical point, a common pin is driven. The head of the pin is then removed, leaving a little less than a quarter of an inch of the pin

projecting. The pin is bent slightly near the tip and ground flat on the two sides, giving it a concave cutting edge.

This instrument is used by directing the concave edge upward and forward, and with it scratching or plowing shallow furrows in the mucous membrane of the dorsal surface of the tongue. This is continued until all the mucous membrane covering the dorsal surface of the tongue, in the region between the papillae at the root and a line drawn across the tongue two or three inches in front of the papillae, has been thus examined. The region described is the one in which the parasites seem usually to be the most numerous. The parasites are revealed through being caught by the pin as it plows its way through the mucous membrane in which they lie.

Infested tongues should be scalded to destroy the parasites after which they should be removed by stripping off the mucosa. This is accomplished by scalding the tongues in water at 145°F. or above, then drenching in cold water in a rotary washer provided with baffles.

Tongues are chilled, sold fresh, pickled, made into sausage or into lunch tongues, either jellied or canned. Tonsils are inedible. Tongues may be frozen and packed in barrels for export.

(c) External Ears. These consist mostly of skin and cartilage. They are removed from the head, and the external canal is trimmed close. The ear must be free from hair, scurf or other inedible material. The ear trimmings are inedible. Ears are sold fresh, used in head cheese, souse and other sausage and in gelatin manufacture.

(d) Lower Jaw. This is pulled away to facilitate the handling of the remainder of the head and then trimmed. No. 1 jawbone trimmings are small lean pieces. No. 2 jawbone trimmings contain about 35 per cent fat. These trimmings are used in sausage. The lower jaw teeth being inedible are removed by machinery. The lower jawbones are then used for lard.

(e) Snout. Snouts consist largely of skin and fat. They are stripped off of the head mechanically, cleaned, chilled, packed in boxes lined with oiled paper and sold fresh or frozen either untrimmed or as trimmed pig snouts. Snout meat contains about 20 per cent of fat and is used in sausage. Snouts may also be pickled or used in sausage.

(f) Hog Lips. These are removed from the lower jaw, cleaned, freed from hair, chilled and used in souse, head cheese or other sausage. Hog lips are mostly fat and skin with little muscle tissue.

(g) Head Trimmings. The fat is removed and used for lard. The muscular tissue is trimmed off. The cheek meat is spread on trays, chilled and used for sausage, fresh or cured, or is trimmed and sold fresh. Trimmed pork cheek meat has 35 per cent of the fat trimmed

off and 5 per cent of the No. 2 pork cheek meat (parotid salivary gland tissue) removed. The "temple" meat is chilled and used for sausage. In some seasons of the year it is packed in tin pails and sold as pork "cutlets." Jowl meat is fat with some streaks of lean (seam meat) running through it.

(h) Brain. The skull is split mechanically, the brain removed, chilled, sold fresh or frozen, canned or placed into sausage.

(i) Head Bones. The upper jaw bones are removed mechanically from the skull and sent to the white grease tank. The skull must have the remaining teeth, the ethmoids and turbinates removed. These are usually ground out. The skulls are then thoroughly washed in a rotary washer, inspected, and go to the lard department.

(6) Genito-Urinary Organs. (a) General. The genito-urinary organs are mainly inedible, however, some medicinal products, casings and food products are obtained from them.

(b) Bladder. When not saved, the urinary bladder is rendered into white grease. When saved for casings, the necks are cut long and all fat is trimmed off as close as possible. To prevent high, piggy odors developing, they are salted twenty-four hours, turned and resalted another twenty-four hours. They are distended and handled much the same as cattle bladders. After drying they may be placed in a weak brine twenty-four hours, and again dried. This results in a well bleached casing.

GRADES OF HOG BLADDERS

(*Packers' Encyclopedia*)

Small Hog Bladders measure 5 inches to 7 inches, are tied 25 pieces to the bundle and packed 200 bundles or 5000 pieces to the barrel. Mark "Small Hog Bladders."

Medium Hog Bladders measure 7 inches to 9 inches, are tied 25 pieces to the bundle, and packed 100 bundles or 2500 pieces to the barrel. Mark "Medium Hog Bladders."

Large Hog Bladders measure 9 inches and over, are tied 25 pieces to the bundle and packed 60 bundles or 1500 pieces to the barrel. Mark "Large Hog Bladders."

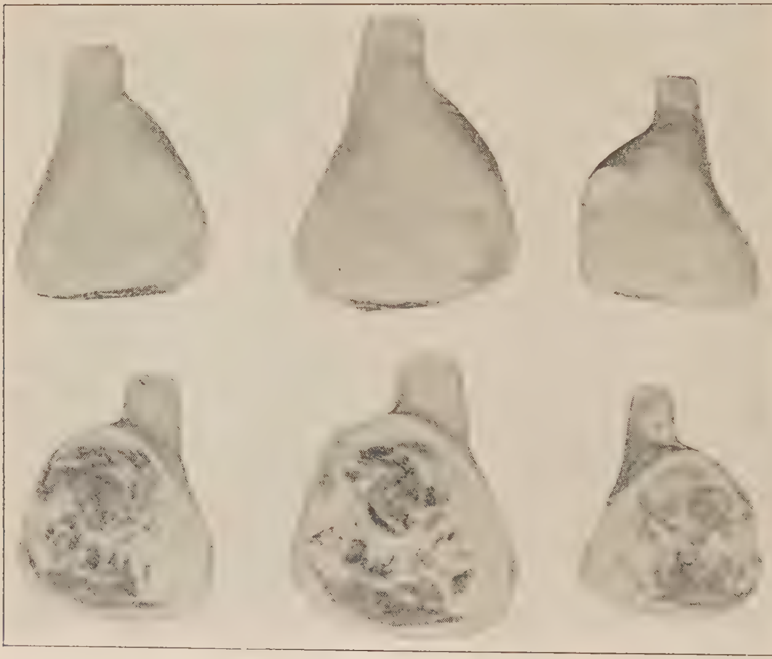
For export trade hog bladders are packed only in boxes; the small and medium grades are packed 5000 pieces to the box, and the large size 3000 pieces to the box.

Bladder casings are used as sausage and lard containers.

(c) Pizzle, Pizzle Pouch and Testes. The penis, preputial diverticulum and testicles are tanked as inedible, being made into white grease.

(d) Female Organs and Fetuses. The uterus, vagina and fetuses are rendered into white grease. Ovaries of pregnant sows are sometimes saved for the pharmaceutical trade.

(e) Kidneys. These are removed at post mortem inspection or later with the leaf fat. They should be stripped of their capsule and inspected. This examination eliminates defective kidneys, including those having glomerular nephritis, degenerations, hemorrhages, hydronephrosis, tuberculosis, kidney worms (Sclerostoma pinguincola) and strong urine odors. Kidneys for the Army should have a firm texture



(Permission United States Bureau of Agricultural Economics)

No. 1 Grade No. 2 Grade No. 3 Grade

FIG. 28. SHORT-CUT HAMS

and a good dark red color. Kidneys are chilled, sold fresh in small lots, frozen for export in boxes, made into stews, mixed with beef kidneys and canned, or go into sausage.

(7) Abdominal Viscera. (a) General. The pluck, including the liver is separated from the remainder of the viscera. The bung gut is pulled, care being taken not to break it; the stomach, caul and spleen are removed; the small intestines stripped, and the ruffle fat separated from the large intestines.

(b) Spleen. The spleen or melt accompanies the caul fat to the lard tanks or is removed, sold or frozen, made into sausage, or rendered into fertilizer. From the Army standpoint it is regarded inedible (see Cattle Spleen.)

(c) Stomach. Hog stomachs may be prepared into hog tripe or used as casings. The linings may be saved for pepsin. They are removed from the intestines and fatted with a knife. For hog tripe they are hung on a hook, split open, turned, being emptied, washed, then put through two hog tripe washers, the second washer being equipped with brushes. The sanitary requirements are that hog stomachs intended for hog tripe shall be from passed food carcasses, cleaned thoroughly with warm water and a stiff brush, or in some equally effective manner and then inspected. This veterinary examination is for cleanliness of product and soundness. Any small red areas, ulcers or other visible lesions due to nematodes (Arduenna strongylina and Physocephalus sexalatus) would require outright rejection of a stomach. The passed stomachs are scalded 15 minutes in boiling water and then chilled in water where the slime is removed by hand. They are then ready for sausage or potted meats. Some stomachs are rendered into lard.

When prepared for casings, hog stomachs are emptied of their contents, washed, trimmed, turned, pickled in iced pickle over night, washed in luke warm water, slimed by hand, inspected (see above), chilled in cold water, salted and packed into 300 pound tierces when they are ready for use as containers for head cheese and sausage. They should be kept under refrigeration, overhauled and resalted every thirty days, as this product is very perishable.

The lining of the heavy red part of the stomach (fundus) may be saved for pepsin, being carefully removed, trimmed from connective tissues, washed very gently in cold water to remove dirt, chilled in ice water, packed in ice, 1200 pieces in a tierce, and kept under refrigeration till used. It requires 4 to 5 linings to weigh a pound. Pepsin is extracted, dried and made into tablets.

(d) Pancreas. This is rendered for lard or made into pancreatin.

(e) Small Intestines. The small intestines, 50 to 65 feet in length, are pulled from the mesentery (ruffle fat) and flushed. About 10 sets are tied in the center to form a bundle. Ten of these bundles are then hung on a small stick and put into a tierce of water over night to chill. In winter the temperature of the water is about 75°F. In summer ice is added. If too cold the casings will become brittle, if too warm the

hog casings will become too soft and spoil. They are then stripped into another barrel of water at 100°–110°F.. where they remain for three to four hours, stripped a third time into another change of water at the same temperature for one and one-half hours, then a fourth time. Fermentative changes take place in these processes loosening the mucosa. The fermenting and sliming of casings should be done only in compartments separate from all other rooms.

The obnoxious, offensive odors incident to the fermenting of hog casings can be reduced materially or prevented when such fermentation is accomplished in a salt brine of 60° strength or less at a temperature of 75 to 85°F. A tierce is filled one-third full of fresh casings which have been hand stripped, brine is added to cover the casings and the casings are kept submerged by means of a weighted rack. Casings are held under these conditions eighteen to twenty-four hours or longer if necessary. While casings produced by this method are whiter, the salt brine has a tendency to harden the casings making them less easy of manipulation without breaking.

The sliming machine consists of a large smooth faced roller and set very close to it are steel knives which are fastened on a small roller. The knives revolve at a speed of 900 revolutions a minute and force the slime from the inside of the casings. In front of the knife roller is a fan roller which prevents the casings from becoming wrapped around the knives. The long roller over which the casings pass is kept wet with water to prevent their sticking to it. Behind the large roller are two small rollers covered with canvas which pull the casings through the sliming machine.

Each set from a bundle is run through the sliming machine separately two times and then placed into cold water. The over cleaners go over each bundle by hand in water at 90–100°F., removing any dirt with knives and cutting the ends square. Hog casings are then inspected and graded, using a small amount of water in each casing or inflating with air. The water in the grading tub is about 90°F.

The duodenum is undesirable. All casings should be free from dirt, slime, odor, stain or other defect. All slimy casings are put through the sliming machine again.

Grades of Hog Casings (Rounds)

No. 1	15 or more feet long
No. 2	6 to 15 feet long
No. 3	2½ to 6 feet long (also known as stumps)

These are graded as wide and medium. Wide casings must be $1\frac{1}{2}$ inches wide. Medium casings are under $1\frac{1}{2}$ inches wide. The average length is 18 feet. They are further graded as "long stuff" which is 12 to 50 feet long and "short stuff" 6 to 12 feet long.

The casings are then bleached in cold 50° pickle for twenty-four hours, this also will remove any traces of odor. Twelve to fourteen pieces are tied in a bundle, salted in coarse salt, piled for 5 to 6 days to dry, then shaken out, resalted in 3 X salt and packed.

All containers should be clean, sanitary and well paraffined inside before being used, otherwise staining of the casings may result. Casings are packed in barrels with 40 to 50 per cent of salt. A bundle with 280 to 300 feet of casings, free from salt will weigh about 11 pounds. Casings are placed into coolers. If properly prepared and packed they will remain in good condition one year.

Hog casings may be utilized in the manufacture of musical strings. Slime is disposed of as in the case of cattle rounds.

(f) Large Intestines. *Hog Bung.* This is the posterior part of the alimentary canal, 3 to 6 feet in length, including the rectum and anal ring or "crown." Bungs are removed and handled with great care as they are a valuable casing. They are flushed, crown and other fats closely trimmed off without scoring or cutting the casing or anal ring, turned, thoroughly cleaned, placed into ice water to chill and shrink, slimed, inspected, graded according to size and condition by inflating them with air momentarily, then handled about the same as hog casings.

Grades of Hog Bungs

Export: $1\frac{13}{16}$ diameter, or more, 18 to 20 inches from crown, free from scores and holes for 32 inches from crown, must be 36 inches long.

Prime: $1\frac{10}{16}$ to $1\frac{13}{16}$ inches diameter, 18 to 22 inches from crown, etc., as for exports.

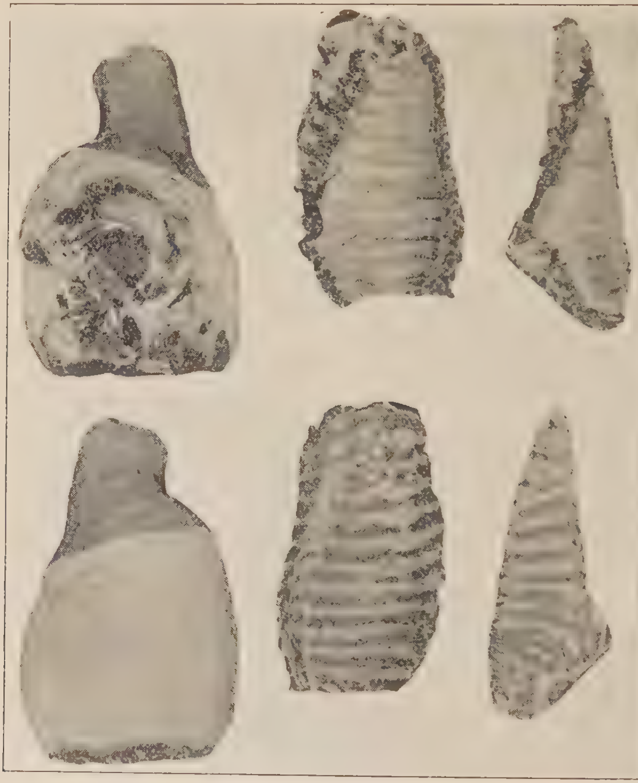
Small Prime: $1\frac{7}{16}$ to $1\frac{10}{16}$ inches diameter, 18 to 20 inches from crown, etc., as for exports.

Skips: $1\frac{4}{16}$ to $1\frac{7}{16}$ inches diameter, 18 to 20 inches from crown, etc., as for exports.

Broken exports, primes, and small primes must measure 14 to 35 inches in length. They consist of broken casings or those with holes or cuts near the crown.

Bungs are tied in bundles of 10, salted and packed in tierces, exports, 400 pieces to the tierce; primes 500; small primes 600, skips 700, broken exports 550 and broken primes 650. After heading, the tierce is filled through the bung with a weak brine solution, and the casings cured in a

cooler six days when they are ready for use or they may be held. They are used for liver and summer sausage casings, some being split and two sewed to form a large bung.



(*Permission United States Bureau of Agricultural Economics*)

Skinned ham — Full sheet Spare ribs — Half sheet Spare ribs

FIG. 29

Middles. These are the large intestines up to the bung and include the cecum. They are 12 to 16 feet in length and bossellated being called the "black guts." The cecum is known as the "pocket." They are used for casings, for food as "chitterlings" or are ground up and used for tankage.

For casings they are pulled, stripped, washed out, held in cold water to harden the fat, placed on a rod where the fat is stripped off, turned,

free end cut off square, washed, slimed, put in cold 50° pickle over night to remove any odor, washed with tap water and salted much the same as hog casings (rounds). They are put up one or two pieces to a set, $7\frac{1}{2}$ to 8 feet in length. The narrow end measures $1\frac{3}{4}$ inches wide, the large end not over 4 inches. They are packed 110 to 150 pieces in a tierce.

Chitterlings are fatted, washed, chilled in ice water when they are sold fresh. Fresh chitterlings can only be held fresh in a frozen state. It is important that they are thoroughly chilled before freezing. They also may be prepared in dry salt, packed in tierces, salt pickle added after the tierce is headed up and then held at 35°F.

(g) Fats. The ruffle, caul and other abdominal fats should be washed clean when they are sent to the lard department. Ruffle fats affected with mesenteric emphysema should have the parts involved removed and rejected.

(h) Liver. The hog liver may average 2 to 4 pounds. After inspection it is trimmed. The bile if not saved is sent to the fertilizer tank. The liver is washed, chilled on trays or racks and some are sold fresh. To hold longer than 4 days, they are frozen. Many are placed into sausage. Export livers are frozen or pickled. If not used for food, they are tanked.

(8) Thoracic Viscera. (a) General. Plucks may be sold whole, either fresh or pickled, in barrels. They are usually separated into their different parts as the liver (discussed above), oesophagus, lungs, trachea, heart, etc.

(b) Oesophagus. This is split, cleaned, inspected, cured and made into sausage, being known as split hog weasand meat.

(c) Respiratory Organs.

Lungs. Due to parasitic invasion, dirt and foreign material from inhalation and dirty tank water from the scalding vats, all hog lungs are considered unfit for human food and are rejected. If intended for fish or animal food they must be from passed carcasses and should be slashed and then denatured by several minutes' dipping in a 1–5000 aqueous solution of methyl violet, after which the excess coloring matter should be removed by washing in clear water.

Larynx. The lean meat trimmings go for sausage, the larynx into inedible grease.

Trachea. The fat is removed and the trachea goes into inedible grease.

(d) Heart. The heart is trimmed, slit, washed free from blood, chilled on trays, frozen to hold, and used fresh, cured, or placed into sausage or potted meats. Fresh hearts spoil rapidly.

(e) "Giblet" Meat. Trimmed pork giblet meat is the diaphragmatic pillars from which 40 per cent inedible products is removed. Part of the giblet meat is removed with the viscera, the remainder going with the carcass. This meat is used in sausages.

(9) Miscellaneous. (a) Fats. All edible fats, trimmings and scraps not otherwise used, are made into lard (see Chapter XI). This includes the retroperitoneal or leaf fat, crotch and other scraped fats.

Leaf fats or other tissues infested with the kidney worms, or parts showing discoloration, galleries or abscesses caused by these worms, should be rejected. The leaf fat may accompany the carcasses of market-dressed swine, but is pulled from packer style dressed hogs, inspected, hung separately in the form of a cone on racks or on hooks in a chill room, chilled at 32° to 34°F. and sold fresh or made into high grade lards as neutral and open kettle rendered. "Tocina" is prepared from leaf fat for the Greek and Italian trade. The serosa is removed, fat sprinkled with salt and spices, cured in layers of two or three pieces, rolled, tied, sliced and sold as a substitute for butter.

Ham facings should be inspected for any condition which renders them unfit for food, as abscesses bruises and wounds.

(b) Thyroids. These may be saved for the pharmaceutical trade.

(c) Suprarenals. These are sometimes saved for medico-therapeutic use.

b. Carcass Pork. (1) General. This section includes a discussion of the classes, methods of grading, grades of and Army requirements for, carcass pork.

(2) Classes. Pork carcasses may be classified in four ways, according to (a) the methods or style of dressing, (b) the type or particular cuts desired, (c) sex and (d) weight.

(a) Style of Dressing. This is based on the uses to which the carcasses are best adapted and the products into which they can be diverted. It varies according to the methods of marketing and trade demand

Market Dressed carcasses include "Pigs" and "Shipper Pigs," being split from the tail to the throat along the inferior median line, through the aitch and breast bones, head on, leaf lard in, vertebrae not split and hams not faced. Less than ½ of 1 per cent of pork carcasses is dressed by this method. Shipper pigs dress out 75 to 76 per cent.

Packer Dressed carcasses include all other hogs as bacon hogs, packing hogs, heavy sows, boars and stags, being split from the tail to the throat along the inferior median line, through the aitch and breast bones, head off, jowls on, leaf lard pulled, hams may or may not be faced, center split, on one side or as in bacon hogs, split on both sides of the back bone (vertebrae). The bulk of hog carcasses are packer dressed being divided into cuts at the packing plants. The dressing yields of all packer dressed hogs, including the head averages 72 to 80 per cent, of smooth heavy lard type hogs 79 to 80 per cent, of good butcher hogs 78 per cent, of bacon hogs 75 to 76 per cent and of sows 72 to 77 per cent. Dressing yields vary with the season, i.e., the temperature, climatic conditions and available feed, being heavier from November to April and lighter from May to September. The heaviest yield is in March, while the lowest is in August. (See Fig. 27.)

(b) Type. This includes the bacon and lard types.

Bacon Type. Hogs of this type are long-bodied, more or less "slab-sided," not carrying any great amount of fat and produce a very desirable belly with the correct proportion of lean and fat for the breakfast bacon trade.

Lard Type hogs are heavy, blocky animals, quick maturing, carrying a large amount of fat suitable for lard, while the bellies are not so desirable for breakfast bacon, being too heavy and having a greater proportion of fat to the lean.

The factors used in classifying hog carcasses under type, considering the particular cuts desired, are conformation, including shape or build, thickness of the carcass, weight, also the amount and condition of the flesh and fat. This includes quality of the fat whether white and firm or soft and oily.

(c) Sex. Sex is not so important in the bulk of animals slaughtered, because they consist principally of young animals. A small percentage, however, are old stags, boars and sows which produce undesirable cuts, both in weight and in quality.

(d) Weight. The principal factor is weight, both as to class and as to grade. Pork carcasses may be classed as follows:

Class	*Weight, Pounds*
Pigs	20 to 60
Shipper Pigs	60 to 130
Bacon Hogs	90 to 170
Packing Hogs	130 to 400
Heavy Sows	300 to 400
Boars and Stags	200 to 400

Each of the above classes is amplified under "Grades."

(3) Methods of Grading. Grades of pork carcasses are not generally recognized as for beef. Selections are usually made according to weight, quality and adaptability for certain cuts or uses. Conformation, finish and thickness while considered are not given the same importance as weight which is the prime factor.

For fresh pork, carcasses should have good conformation, even straight lines, good width in proportion to the length with plump, full rounded backs, hams and shoulders. Bacon hogs should be comparatively long, narrow with long thick sides and long tapering legs. Generally for pork carcasses the flesh should be of good quality, bright in color, smooth, fine grained and firm; the fat over the carcass should be thick, white and firm and not discolored, soft or oily; the skin should be thin, smooth and free from coarseness, wrinkles and blemishes and the bones should be well proportioned and reasonably soft. The relative weight of the carcass to the cuts made therefrom is also considered.

"No Grade" carcasses are those which have not passed a satisfactory recognized veterinary examination in accordance with Army Regulations, those not bearing the inspection legend of an authorized sanitary inspection agency, or which have not been properly stored or handled subsequent to inspection, and those unsound, unwholesome or unfit for human consumption in any manner.

(4) Grades. (Includes an amplification of each class.) (a) Pigs (Bureau of Agricultural Economics):

The percentage of pigs slaughtered is relatively small. Such carcasses are found on the larger markets in limited numbers during the Christmas and New Years holidays, but rarely at other seasons. They are sold principally to hotels, restaurants and clubs for roasting whole and to some extent by the retail trade in quarters or sides to family trade. They are never divided into hams, shoulders, bellies, etc., as is the case with larger carcasses. Neither is the meat from such carcasses cured but is sold fresh entirely. The flesh is uniformly light in color and very tender. They are dressed with the head on and the carcass is usually opened only from the crotch to the brisket.

(See "No Grade" carcasses, Methods of Grading.)

(b) Shipper Pigs. (Bureau of Agricultural Economics):

This term describes a class of hog carcasses which are dressed with head on. They are marketed generally in the carcass and is the only class of hog carcasses which are not divided into cuts at the packing house. The comparatively light average weight makes such carcasses desirable for retail trade especially during late fall and throughout the winter months. Small country packers who cater

to suburban meat trade, both retail stores and family trade, prefer carcasses of this weight as they make light handy weight cuts, and also produce trimmings suitable for high class sausage. In general shipper carcasses are preferred by small packers who are not equipped to do slaughtering and who market the bulk of their out-put as fresh pork. Such carcasses, however, make desirable bellies for curing as breakfast bacon and this cut is marketed principally as cured pork.

Carcasses of the same average weights are also found in the bacon class, but these are not marketed fresh to any extent but are cut into "Cumberlands" and "Wiltshires" at packing centers and cured for export trade. They are of a different type than shipper pig carcasses, and have relatively longer bodies and thinner sides, shoulders and hams. They also make less desirable loins. Shipper pig carcasses are comparatively plump, have broad backs, and full thick loins, shoulders and hams, and relatively greater amounts of fat. In a word, shipper pigs resemble lard type hogs in all respects except age and weight, being always from comparatively young animals. There is very little difference in the quality of shipper pigs as thin carcasses are not used for this trade. The weight is the governing price factor.

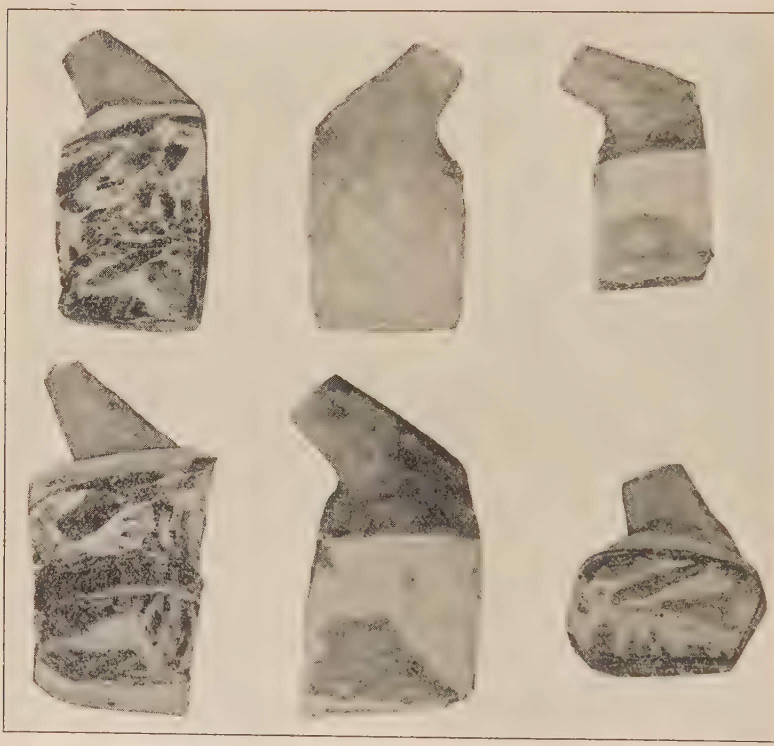
(See "No Grade" carcasses, Methods of Grading.)

(c) Bacon Hog Carcasses. *General.* (Bureau of Agricultural Economics):

The term bacon when used in connection with hog carcasses refers to a special type or class, which is best adapted for making comparatively lean cuts for curing. Cuts from carcasses of this class are rarely sold as fresh pork. The type of hog which produces bacon carcasses is easily distinguished from packing hogs or lard hogs. They are longer bodied and relatively narrow through the back, and have longer legs and carry little or no surplus fat. On account of the relatively high percentage of lean meat as compared to other classes, these carcasses make ideal cuts for curing as bacon, hence the term "bacon hogs." Cuts from carcasses of this class are generally sugar cured and only in exceptional cases are they cured in any other way. The hams should be full but lean and the shoulders light and smooth. The flesh is firm and the fat is clear white and firm. Watery or oily flesh indicates poor quality. Bacon hog carcasses are cut on each side of the back bone and the entire back bone or chine is removed in one piece. This method of dividing the carcass differs from the method ordinarily followed and is necessary when making cuts for English trade. The growth of the English trade and the domestic demand for lean breakfast bacon have been factors in increasing the production of the bacon type hog. The English Cuts made from carcasses of this class are "Cumberlands," "Wiltshires" and "English Bellies." Sugar cured breakfast bacon for domestic trade, also short cut and long cut hams and Italian hams are made. Dublins are made principally from the lean and lighter weight carcasses.

While grades are not generally recognized, selections are made according to the cuts for which the carcass is best suited. This involves the thickness of sides, thickness of fat over the carcass, grain of the meat, size and hardness of the bones, smoothness of the skin, condition and quality of fat and relative weight of the carcass and cuts made therefrom.

While weight is the prime factor which determines the relative value of the cuts made from bacon hog carcasses, there are other factors which determine the adaptability of the carcass for special cuts and these are given consideration. These differ to such an extent as to render grades advisable in order that the selection of carcasses according to the methods of curing and demand of the trade may be made to the best advantage. The grades are choice, good, medium and common.



(Permission United States Bureau of Agricultural Economics)

FIG. 30. PORK SHOULDERS

Top row: New York shoulders, skinned New York shoulder
Bottom row: Rough shoulder, skinned regular shoulder, picnic

Choice (Bureau of Agricultural Economics):

Carcasses of this grade are evenly fleshed and covered with a smooth layer of firm white fat, over the loins, shoulders and sides. Such carcasses have thin smooth skin which is comparatively tender. The flesh is uniformly firm, fine grained and light pink in color. The depth of back fat is from one and one-

fourth to two inches and evenly distributed over the back and shoulders. The sides are of an even thickness and relatively broad. Interior fats are smooth, very brittle and clear white. Carcasses of this grade are principally from the heavier weights of bacon hogs. They make desirable "Wiltshire" and "Cumberlands," also "English" backs and bellies. The best grades of breakfast bacon for domestic trade are also made from this grade. Carcass weights range from 130 to 170 pounds.

Good (Bureau of Agricultural Economics):

This grade includes those carcasses which lack the high degree of finish or are too thickly or unevenly covered with fat to grade choice. Carcasses which are slightly deficient in conformation, and lack sufficient length or depth of sides for the choice grade are found in the good grade. There may be also a slight deficiency in firmness and quality of flesh and fat as compared to the choice grade but these are not to a marked degree. This grade contains a much larger percentage of carcasses than the choice grade and generally there is no marked differences in any respects. The thickness of back fat varies but is not less than one or more than two and one-half inches. Interior fats correspond in quality to those of choice carcasses. They make good average quality "Wiltshires," "Cumberlands," "Long Clear Sides" and "English Bellies." The bulk of breakfast bacon for domestic trade is made from carcasses of this grade. The range of carcass weights is wider than those grading choice and are from 110 to 170 pounds.

Medium (Bureau of Agricultural Economics):

Under normal conditions there is a relatively small percentage of bacon hog carcasses in the medium grade. This grade comprises carcasses which have poor conformation, an excess or deficiency of fat which is unevenly distributed, or carcasses which are very angular and lack the depth and breadth of sides necessary for making fancy bacon cuts. The quality of the interior fats varies but is usually tough and slightly yellowish. Such carcasses have moderate amounts of fat interspersed through the lean of the bellies and they make a fair grade of bacon. A small percentage of "seedy" carcasses are usually found in the medium grade. Sides from carcasses of this grade are made into "Dublins" for export trade, and the hams are used extensively for curing to supply the export demand for lean meat. The bellies are also cured for low grade breakfast bacon. Carcass weights range from 80 to 140 pounds.

Common (Bureau of Agricultural Economics):

Common bacon hog carcasses are the lowest in quality, finish and average weight of this class. They have little or no fat covering. Such carcasses reflect the lack of proper nourishment and are soft and flabby. The flesh is comparatively dark and coarse grained and frequently watery in appearance. The skin although thin, is tough and lacks the smoothness of the higher grades. Such carcasses, however, are in relatively small numbers and are usually only a minor factor in the industry. Carcass weights range from 70 to 130 lbs.

"No Grade": (see Methods of Grading).

(d) Packing Hog Carcasses. *General.* (Bureau of Agricultural Economics):

The term packing hogs refers to a class, the carcasses of which are converted into cuts for the general trade, and only a relatively small percentage are cured by the same methods as cuts from bacon hog carcasses are cured. Hams and shoulders from packing hogs are usually cured in sweet pickle, while all other primal parts from carcasses of this class are dry salt cured. Loins are an exception, however, as a large percentage of these are sold fresh. This is always true when carcasses are cut for dry salt bellies and backs. When they are cut for short ribs and short clears the loin is a part of those cuts and it is cured and sold as dry salt meats. The highest yields of lard are also obtained from carcasses of this class. Packing hog carcasses are relatively short and compact, have broad meaty backs, short stocky legs, thick blocky hams and shoulders and thick sides. They also have relatively greater amounts of interior fats. All parts of the carcass are thickly covered with a firm clear white fat, having its greatest depth over the back and sides. The range of weights is wide and includes extreme heavy weight carcasses and light carcasses of both barrows and sows. The shape or conformation most desired in packing hogs is breadth, width and thickness of sides and back in proportion to length of body. There should be straight even lines and short blocky hams and shoulders. In bacon hogs, length of body or side is more important with less width and thickness of back in proportion to that of the sides in the grades of packing hogs. Finish refers to the depth and evenness of fat covering the carcass, especially along the back and over the sides, also the amount and quality of leaf and kidney fat. Quality implies firm, bright, smooth grained flesh and firm white fat evenly distributed over the carcass; smooth, thin skin free from wrinkles, blotches or bruises; proportionately small shanks and comparatively soft red chine bones, back-bones and brisket-bones. Points of importance in selecting dressed hogs are the development of loins and sides and the size, shape, firmness and the covering of the hams and shoulders. Coarse or extremely large shoulders, neck and jowls are indications of stagginess. The importance of weight, while being the greatest single factor, varies considerably according to the sub-class or grade. Packing hog carcasses are divided for convenience in handling and curing into four sub-classes or grades. These are butcher carcasses, heavy packing, medium packing and light packing carcasses. (See Fig. 27.)

Butcher Hog Carcasses (Bureau of Agricultural Economics):

The term "Butcher" refers to a class of hog carcasses from which light loins of desirable weights and quality are made. In a broad sense such carcasses possess some of the characteristics of both the bacon type and the packing type. They have the right proportions of lean and fat and make relatively small cuts which are in most demand by the retail fresh meat trade. The term therefore has reference to the class of trade for which such carcasses are best suited. Carcasses of this class from which loins of desired weight and quality are made, should weigh between 150 to 230 pounds. Good conformation, which involves well proportioned hams, shoulders and sides is essential, as is also thick firm

flesh, smooth soft skin and firm white fat. The covering of fat, however, has less depth than other grades of packing hogs. Such carcasses are from barrows and smooth sows. They are principally cut up by packers. Practically all the loins from this class are sold fresh and a large percentage of the shoulders especially during the winter months. Picnics and butts are also made from the shoulder and a large percentage of these are marketed fresh. Other cuts which are made are fat backs, clear bellies, extra ribs, extra short clears and hams. The latter are always cut short.

Heavy Packing Hog Carcasses (Bureau of Agricultural Economics):

Carcasses of this class vary in quality and conformation to a considerable extent. While the bulk of this class consists of carcasses from heavy barrows it also includes a fair percentage of rough seedy sows and a relatively small percentage of boars and stags. Such carcasses are usually too heavy and too coarse to make loins of desirable average weight and quality, also bellies suitable to curing in sweet pickle; hence the bulk of dry salt meats and barrelled pork is obtained from carcasses of this class. Carcass weights range from 240 to 400 pounds, with the heavier part of the range consisting mostly of sows, stags and boars. A small percentage of rough coarse barrows are also found in the extreme weights, but the bulk of these weigh from 240 to 300 pounds. Defects which are common to carcasses of this class are comparatively thick, rough and wrinkled skins, dark colored and coarse grained flesh, large bones and skin bruises. Soft and oily carcasses are also frequently found in the class. Short ribs and mess pork are largely made from heavy packing carcasses although fat backs, rib bellies, also loin backs are made from the smoother and lighter weight carcasses. The hams are mostly skinned and cured in sweet pickle for the skinned ham trade, also for boiling.

Broad, or three rib shoulders for curing in dry salt, are made from carcasses of this type, as are also heavy picnics and Boston butts.

Medium Packing Hog Carcasses (Bureau of Agricultural Economics):

Carcasses of this class consist mostly of barrows and relatively smooth sows. The weights range from 190 to 240 pounds, but they are inferior to butcher hogs in quality. They also have less regular conformation and the flesh is darker and its grain is coarser. Carcasses of this class are not as well adapted to making cuts for the fresh meat trade as are butcher carcasses, but a large percentage of the loins are marketed fresh. The cuts which are usually made from such carcasses are dry salt clears, short ribs, fat backs, dry salt rib and clear bellies, short cut hams and New York cut shoulders and picnics.

Light Packing Hog Carcasses (Bureau of Agricultural Economics):

Carcasses of this class are from barrows and sows which are too deficient in conformation, quality and finish to be classed as either bacon, butcher or shipper carcasses, and weigh from 100 to 200 pounds. They are principally from comparatively light thin and relatively young sows. Such carcasses usually carry little excessive or surplus fat and they make comparatively lean cuts. They

make desirable short ribs which are usually converted into mess pork. Fat backs, clear bellies, short cut hams, picnics, New York shoulders and skinned shoulders are also made from the carcass. The sides are too thin and light to make desirable rib bellies for the dry salt trade but they make clear bellies of average quality for curing in sweet pickle for breakfast bacon. As a rule such carcasses have too much fat to make desirable cuts for English trade.

"No Grade" Packing Hog Carcasses. (See Methods of Grading.)

(e) Heavy Sow, Boar and Stag Carcasses. *General* (Bureau of Agricultural Economics):

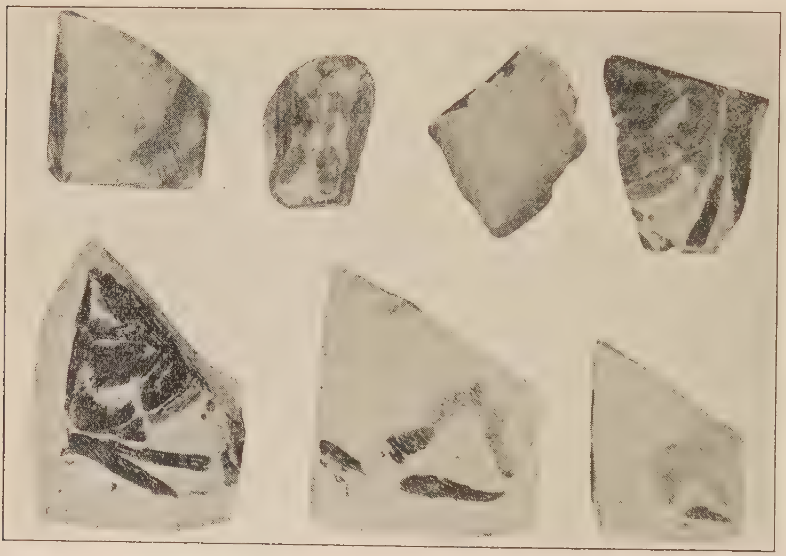


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FIG. 31. PORK CUTS

Top row: Boston butt, picnic butt, raw leaf lard, boneless butt
Lower row: Dry salt regular plate, dry salt clear plates (two averages)

Although carcasses of heavy sows, boars and stags are included in the grades of packing hog carcasses, separate descriptions according to sex and the degree of sex development for purposes of identification are advisable. The difference in quality and market prices, particularly of sows, as compared to boars and stags makes such descriptions necessary.

Heavy Sow Carcasses (Bureau of Agricultural Economics):

This term refers principally to carcasses from old sows which have been retained on farms or ranges for breeding purposes, for an indefinite period. Car-

casses from young sows which were not bred compare very favorably with carcasses of barrows, and no distinction as to price of the live animal, is made on any of the markets. The meat from old sows, which are usually referred to on the hoof and in the carcass as heavy packing sows, is comparatively coarse, tough and dark in color. Such carcasses have poor conformation and produce relatively soft and flabby sides or bellies. This class also produces what are commonly referred to in the trade, as "seedy" bellies. Heavy sow carcasses have rough wrinkled skin and it is usually moderately thick and hard to cut. The bones are hard and lack the redness of those in young animals. They are distinguished from carcasses of boars and stags by the teats and broad thin sides, and relative size of hams, and shoulders.

Sow carcasses have unusually broad forequarters which are relatively heavier than the hindquarters. Boars and stags are just the reverse, having proportionately heavier hinds than fores. Carcass weights range from 300 to 400 pounds.

Boar and Stag Carcasses (Bureau of Agricultural Economics):

Boar carcasses are from male animals which were not castrated or which had been castrated after all the sex characteristics had fully developed. Carcasses of stags are also from male animals and differ from boar carcasses only in less development of sex characteristics, due to a shorter period of breeding activity. The cuts from carcasses of both boars and stags are handled and marketed the same. For all practical purposes, a description of the cuts and methods of marketing will be applicable to both. Carcasses have exceptionally heavy hind quarters in proportion to fores, and the hams are short, thick and blocky. The skin is coarse and thick and difficult to cut. The flesh is dark and the fat has a yellowish tinge. The flesh of old boars has a decidedly strong odor, but it is not so pronounced in stags. The meat even when cured, retains the odor. Its sale in primal parts is therefore very restricted and such parts of the carcass as are marketed in cuts are sold generally to a class of trade that is not discriminating. Picnics are usually made from the shoulders and sold at a heavy discount under those of standard quality. These other cuts, including bellies and sides, are cured in dry salt. A large percentage of such carcasses are made into trimmings and used in the manufacture of sausage. The fat is rendered into a low grade lard and this too retains the odor for an indefinite period.

"No Grade" carcasses. (See Methods of Grading.)

(5) Army Requirements. These include the sanitary requirements of the Surgeon General, and, if purchased under the Quartermaster General, such purchase requirements as may be specified.

The sanitary requirements are outlined in section 8 of this chapter. It is important that pork carcasses are properly dressed and trimmed. Lungs should be removed from all "Pigs" and rejected. All scurf, hair and other defects, as outlined in Rail Inspection of Hogs (Chapter VI), should be removed, the ears singed out and the nose and mouth thoroughly cleaned with a jet of steam. Trichinae are

discussed under "Pork Trimmings." Handling of pork carcasses and refrigeration are contained in sections 6 and 7 of this chapter.

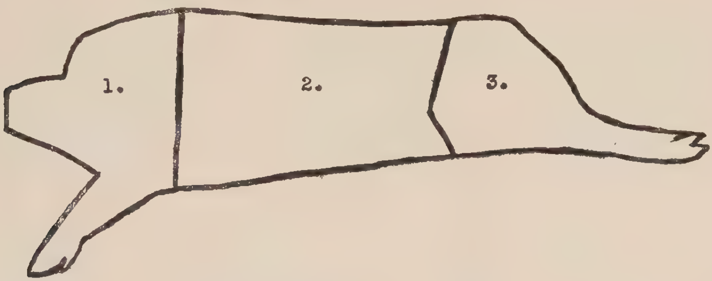
The better grades of carcass pork should be selected (see Methods of Grading) from recently slaughtered animals in prime condition. This would eliminate oily and soft hogs.

The quality of pork varies according to the feed. Hogs fed exclusively on peanuts, slops, acorns and nuts yield soft and flabby pork. After chilling out thirty-six to forty-eight hours at 32°F., such pork does not become firm, but remains soft and pliable and it does not permit of trimming into attractive, salable cuts. The fat is soft and yellowish white to a brownish tint. The flesh lacks firmness, grain and bright color. Cuts do not cure well and the trimmings produce a greasy sausage of inferior quality. Lard from an oily carcass is yellowish in color, soft and tends to become rancid quickly.

The corn fed carcass when chilled thirty-six to forty-eight hours at 32°F., becomes firm. The flesh is firm, bright in color, and fine grained. The fat is white and firm. Carcasses can be cut cleanly with a cleaver or knife, the cuts being shapely and firm. The lard from such a carcass is firm and flakey and the trimmings will produce a first-class sausage. There are all gradations in quality of pork carcasses between the two extremes described above.

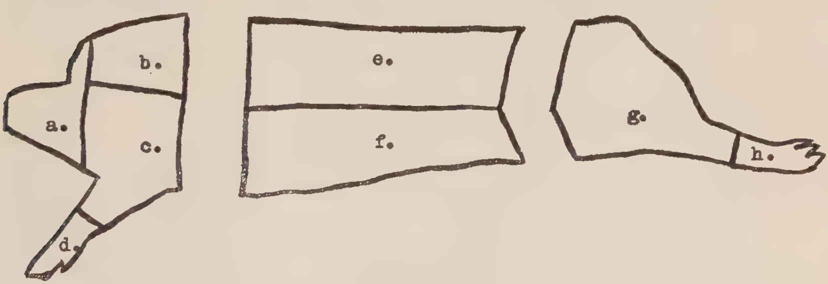
c. *Pork Cuts.* (1) General. Ninety-nine per cent of hogs slaughtered in abattoirs are made into standard pork cuts. Twenty per cent of these cuts are sold fresh while the remainder are cured. The cuts of pork and their variations are numerous. "Clear" denotes absence of all bones, "Extra" refers to the loin being removed. After a thorough forty-eight to seventy-two hour chill (see Storage) hog carcasses are run into the pork cutting room, which is equipped with tables, band saws, rollers, trucks, scales, chutes and other apparatus for the division of the carcass into cuts and their further preparation. There are sometimes several rooms, one below the other, connected by means of chutes. The hog carcass is divided on the top floor, each side being separated usually into three primal cuts which then gravitate through chutes successively to the floors below where they are subdivided, trimmed, weighed, graded and placed into trucks, boxes, barrels or other containers ready for shipment, for the curing cellars or for the freezer. The trimmings are further trimmed, graded and made ready for lard and sausage. Carcasses are divided in numerous ways depending on trade demand, season, and the temperature conditions.

The cords of the hind legs holding the gambrel sticks are cut and the pork carcass falls on a table where it is separated with a knife into two rough sides. A rough side, the entire side of a hog carcass, is not used as such but usually is divided into three primal parts, viz., a rough ham, the most posterior part of the rough side, including some of the pelvic bones, the ham, tail, and feet; a rough shoulder, the anterior



Initial Cuts

1, Rough Shoulder; *2*, Rough Short Ribs; *3*, Rough Ham. *1*, *2*, *3*, Rough Side.



Secondary Division

Fig. 32. Standard Wholesale Market Cuts of Pork

a, Jowl; *b*, Shoulder Butt; *c*, Picnic Shoulder; *d*, Fore Foot; *bc*, Shoulder; *abcd*, Rough Shoulder; *e*, Rough Back; *f*, Rib Belly; *ef*, Rough Short Ribs; *g*, Short Cut Ham; *h*, Hind Foot; *gh*, Rough Ham.

portion of the rough side, including part of the scapula, the fore leg, jowl and neck bone, and, the rough short rib, the middle portion of the rough side, including the fat back, belly, loin, spare ribs, and part of the back bone.

The first four ribs of a side are cut through at their extremities by a cleaver and turned back with a knife. For American short cut hams, the vertebrae are sawed through at about the sacrococcygeal

articulation. The pelvic bones are divided through the shaft of the ileum allowing the superior part of the ileum (slip bone) to remain on the loin and the remaining pelvic bones (the hench, aitch, tail or hip bones) in the ham. This point of division is about two or three fingers' width in front of the exposed aitch bone. A knife then is used to separate the rough ham from the side. Long cut hams are detached from the side usually at the "slip" joint. A long cleaver is used to cut the rough shoulder from the rough short rib. This cut is usually made just posterior and close to the elbow. These primal rough cuts then gravitate to the floor below where they are sub-divided into market cuts which are trimmed, graded, weighed, some being sent to the curing cellars, while others are wrapped, packed and sent out as fresh cuts or are frozen.

(2) Description and Utilization of Pork Cuts. (a) Rough Hams. These are divided into *short cut* or *long cut* hams, *feet*, *tail*, "tail bones," ham skins and trimmings. On the second cutting floor the hind feet are sawed off, the hams are trimmed, graded and placed into trucks. The skin and part of the fat of some hams are removed with a semicircular draw-knife to produce skinned hams. On certain styles of long cut hams the pelvic bones are removed exposing the femur head. Knives are immersed frequently in boiling water to remove grease and to aid in cutting. The feet, tail and other trimmings gravitate to floors below for further preparation.

Short Cut Hams include the standard American, skinned, boneless and Bayonne hams.

The Standard American short cut hams are made principally from butcher hogs which have plump hams with desirable proportions of lean and fat. They are severed from the rough sides at the sacrococcygeal articulation and the feet cut off at or above the hock. When cut off at the hock the marrow canal is not exposed. This cut is the more desirable. The hams are trimmed round at the butt, cushion full faced but not undercut on the skin side and the loose or gut fat removed. They weigh from 8 to 16 pounds. (See Fig. 28).

Very few hams are sold fresh, some are cured in dry salt and smoked but most of them are sweet pickle cured and smoked.

Very fat and skin bruised hams are skinned to reduce the high percentage of fat and to render defective hams more salable. The surplus fat and skin are removed down to within, at most, four inches from the shank, leaving about one-half to one inch, but not more than one and one-quarter inches of fat covering the hams where the skin has been

removed. The fat is leveled back at least three inches from the lean meat of the butt. The hams are then neatly rounded and beveled on the cushion and flank. They weigh from ten to thirty pounds, the bulk being from 14 to 20 pounds. Skinned hams are used for boiled hams and for slicing. (See Fig. 29.)

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FIG. 33. PORK CUTS

Top row: Loin butt, boneless loin butt, loin butt, bone in
Middle row: Bacon squares, brisket, loin butt
Bottom row: Jowl butts, neck bones

Boneless hams are made from standard sweet pickle or skinned hams by lifting the skin, (if any), removing the bones and surplus fat, replacing the skin, (if any) folding the small end in, tying in the form of a roll or by pressing into a flat, oval or round shape (see Chap-

ter XII). They average 14 to 22 pounds and are used as boiled or cooked meats.

Bayonne hams are short cut, shank bent back, trimmed round and closely faced. These are export hams.

Long Cut Hams include regular long cut, York, Virginia, Stafford, Manchester, Italian, French, Dutch, Hamburg and other style hams. They usually are made from lean hogs of the bacon type and are cut longer at both the butt and shank than are the short cut and have only ½ to 1½ inches of outside fat.

The "Regular" long cut ham is severed from the rough side at the slip joint and the foot removed at the fetlock. They are not faced, the butt is left full, giving the cut a long flat appearance. They average 10 to 20 pounds.

York hams are butted closer to the slip bone.

Virginia or Smithfield hams are very lean.

Stafford hams are cut two inches shorter at the butt than regular long cut hams and the hench bone is removed, exposing the head of the femur. They weigh 12 to 16 pounds.

Manchester hams are very lean and flat, butted and trimmed like a Stafford with the hench bone left in. They average 12 to 18 pounds.

Italian hams are very thin, flat, long hams made from thin bacon hogs. The leg is left extra long, butt trimmed, like the standard short cut hams and hench bone removed. They average 9 to 18 pounds. They are pressed flat, cured, smoked dark and seasoned with pepper.

French hams while butted close to the aitch bone are cut long in the leg, faced and trimmed closely.

Dutch hams are longer than the regular long cut ham at the butt, the shank is cut off at the fetlock. They are trimmed close, moderately faced and butted to a point.

Hamburg hams are long cut with shank unjointed below the hock joint and aitch bone removed.

Hind feet coming from the cutting floor have all of the hair, scurf and dirt removed by hand or machine. They are trimmed by hand, care being taken to remove the contaminated back tendons and interdigital tissues after which they are washed in a rotary washer and rendered into lard or glue. Only occasionally are they pickled. Many hind feet have shackle bruises and should be rejected.

Tails are trimmed, chilled, packed in paper lined boxes and sold fresh for boiling or stews. Some are cured in dry salt or pickle, others are used in sausage or frozen.

"Tail" bones removed from certain hams are handled fresh or frozen, packed in barrels or boxes.

Ham skins are sometimes used in leather manufacture.

(b) Rough Shoulders. These are divided into various style *shoulders, butts, plates, jowl butts, neck bones, blade bones, hocks* and *fore feet.*

Shoulders include various styles as *regular, New York, skinned, shankless skinned, New Orleans, picnic, boneless picnics, picnic butts,* and *square shoulders.*

The fore feet are sawed from the rough shoulder, which is trimmed free from neck bones, ribs, jowl and other tissues or the shoulder butt removed and picnic shoulder trimmed up. The shoulder butt may be further divided into the clear plate and Boston butt or the regular plate and the boneless butt as described later.

The rough shoulder as it comes from the rough side contains the jowl. It is sometimes trimmed with jowl cut square and sold as a rough shoulder. (See Fig. 30).

Regular shoulders have the foot cut off above or at the knee joint, fat end butted, ribs and neck bones removed, breast flap trimmed off, and neck squared. They average 12 to 16 pounds. Heavy shoulders run as high as 20 pounds. They are made from rough, heavy hogs and are cured in dry salt or pickled. (See Fig. 30).

New York shoulders are made from smooth hogs. They are two ribs wide, the foot cut off one inch above the knee joint, butted one inch from the blade bone, trimmed smooth, neck bones, neck and breast flap removed and trimmed close. They average 8 to 16 pounds. They are handled fresh or pickled. Some are packed in boxes and frozen. (See Fig. 30).

Skinned shoulders are the same as New York shoulders except the skin and surplus fat are removed to the shank. Weight: 6 to 16 pounds. They are handled fresh or pickled. (See Fig. 30).

Shankless skinned or Chinese shoulders are made from skinned shoulders. The hock is removed close to the breast, all of the skin removed and fat trimmed close. They are sold fresh to Chinese restaurants.

New Orleans shoulders are cut one and one-half ribs wide or one to two inches narrower than regular shoulders. The shank is cut off below the knee joint, part of the neck is left on, and the neck bone removed. They are not faced and only slightly trimmed. Weight: 10 to 16 pounds. They are cured in dry salt.

Picnic shoulders, standard picnics or calas, are cut two and one-half ribs wide, the shank cut off above the knee, the shoulder butt cut off

leaving not less than one inch and not more than two and one-half inches of scapula in the picnic, well rounded at the butt, breast flap and all loose tissues removed. They are made from butcher and packing hogs and from old sows, stags and boars. They average 4 to 12 pounds. "Stag" picnics include those over 12 pounds. Many heavy picnics are skinned. They are pickle cured. (See Fig. 30).

A percentage of the heavier picnics are skinned, boned and rolled.

A picnic butt is a picnic free from surplus fat and skin, with the shank cut off close to the breast. (See Fig. 31).

Square, three rib or *English shoulders* are made from smooth packing hogs, cut fully three ribs wide, through the cartilage of prolongation of the scapula, foot removed at or above the carpus; the ribs, neck bones and breast flap removed and squared at the butt and neck. Weight: 10 to 18 pounds. They are usually cured for export.

Butts include the *shoulder butt, clear shoulder butt, Boston, Milwaukee, boneless* and *Buffalo butts.*

A *shoulder butt* is the butt end of the shoulder after the picnic is removed. It contains the neck bones and part of the scapula and is trimmed square at the neck with the butt flare cut close.

A *Boston butt* is the lean portion of the shoulder plus some of the fat, after the clear plate is removed. It is about two-thirds lean and one-third fat, and also contains a portion of the scapula. The neck bones, ribs and excess fat are removed. The lean is an extension of the loin. They average 3 to 7 pounds. (See Fig. 31).

Milwaukee butts are the same as Boston butts except the ribs and neck bones are left in.

A *boneless butt* is the solid lean piece of the Boston butt beneath the scapula. Boneless butts average 2 to 5 pounds. When cured and smoked they are called "Cottage" butts or rolls. They are also sold fresh or made into sausage.

A *Buffalo butt* is the same as a boneless butt, except the ribs and neck bone remain.

Plates include the *clear* and *regular plates.*

A *clear plate* is the continuation of the fat back, being the top part of the shoulder butt after the removal of the Boston butt. It consists of the skin, fat and a small amount of lean meat. Clear plates are trimmed smooth at the edges, resemble a key stone in shape and average 4 to 8 pounds. (See Fig. 31).

The *regular plate* is the top part of the shoulder butt after the boneless butt is removed. The neck side is squared. It contains part of

the scapula, has a moderate amount of lean meat and averages 6 to 12 pounds. Plates are dry salt cured and used for barreled pork. (See Fig. 31).

A *jowl butt* is the fatty portion between the shoulder and jaw, slightly faced, edges trimmed smooth and close. Weight: 2 to 5 pounds.

Square cut jowl butts or bacon squares are trimmed square and contain a small amount of lean and some glandular tissue. Weight: 2 to 4 pounds. Bacon squares are cured and smoked. (See Fig. 33).

Neck bones, the vertebrae of the shoulder and neck, together with the *shoulder ribs* (if present) are sold fresh or are tanked for lard. They spoil rapidly if not kept refrigerated. (See Fig. 33).

Blade bones are handled fresh or frozen, packed in boxes and barrels.

Hocks, that portion of the fore legs from the knee to the elbow joints-are sold fresh or are pickled, being handled loose or packed in half, barrels or barrels.

Fore feet are cleaned, trimmed, scraped and sold fresh or are cooked, split, pickled (see Cured products), spiced and packed in kits, half-barrels or barrels.

(c) Rough Short Ribs. These are divided into *short ribs*, *short clears*, *backs*·and *bellies*. *Long fat backs* and *long cut loins* are also considered. (Also see Classes and Miscellaneous Cuts.)

The rough short ribs are scribed across the length of the ribs with a scribe saw. The loins may be pulled out with a semi-circular draw knife; trimmed, weighed, wrapped in paper, packed in boxes and shipped fresh or frozen. The extra short rib that remains is rolled flat. If scribed too deeply a tear may result from rolling. These ribs may be trimmed and placed into dry salt cure or further divided. The spare ribs are pulled with a knife or special draw knife leaving an extra short clear which is cured or further divided into a clear belly and a fat back. Other cuts are also made as described later.

Short ribs may include the *"Short rib," hard short ribs, soft short ribs, regular short ribs* and *extra short ribs*.

A "Short Rib" is a rough short rib with the tenderloin removed. (See Fig. 48).

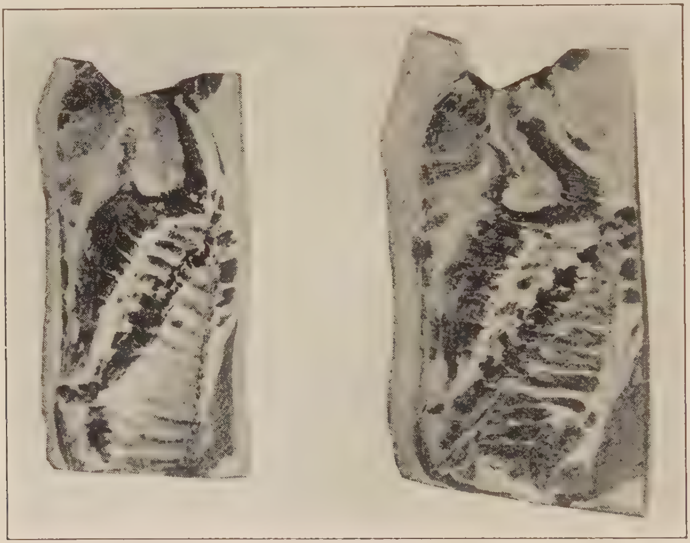
A *hard short rib* is the side of a carcass after the ham, shoulder and tenderloin have been removed and contains all of the back bone. Weight: 50 to 70 pounds. They are cut from heavy packing hogs. The opposite side is called a *soft short rib*.

A *regular short rib* or "Ribs" is the same as a soft short rib with the slip and breast bones cut down smooth. Weight: 25 to 80 pounds. They are dry salt cured.

An *extra short rib* is the same as a rough short rib with the loin removed. Weight: 35 to 50 pounds.

Short Clears. These include the *regular short clear* and the *extra short clear.*

The *regular short clear* is the same as a rough short rib with the back bone, full sheet spare ribs and tenderloin out and ends squared. Weight: 30 to 70 pounds.



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Rib belly (showing scribe-sawing) Clear belly

FIG. 34. DRY SALT AMERICAN BELLIES

An *extra short clear* is the same as a rough short rib with the spare ribs, breast bone and loin removed, i.e., it consists of a clear belly and fat back in one piece. Weight: 25 to 60 pounds. They are cured in dry salt and smoked. (See Fig. 48).

Backs include *rough, rib, hard, short clear,* and *short fat backs. Long fat backs, fat back skins, regular loins, long cut loins, tenderloins* and *back bones* are also considered.

A *rough back* is the rough short rib minus the belly portion.

A *rib back* is the rough back with the back bone and tenderloin out, edges trimmed smooth and squared. Weight: 20 to 45 pounds. (See Fig. 36).

A *hard back* is made from a hard short rib.

A *short clear back* is a rib back with all ribs removed and the tail bone cut off even with the face of the meat. Weight: 16 to 40 pounds.

A *short fat back* is a rough back minus the loin. It contains no bones, and very little lean meat, being mostly fat. They are cut principally from extra short clears, from butcher and packing hogs. Weight: 8 to 24 pounds. They may be cured in dry salt or skinned and made into lard or sausage. *Export fat backs* are thick, heavy fat backs. *Paprika fat backs* are light, thin fat backs, 4 to 8 pounds, sold fresh or cured in dry salt and seasoned with paprika. *Fat back skins* are removed by hand or with a machine. The fat removed from the skins goes for lard and the skins cured in fine dry salt or brine for leather. A few skins are made into souse, head cheese or other sausage. (See Fig. 36).

A long fat back consists of the short fat back and the clear plate in one piece.

Loins include *regular short loins, loin rolls, tenderloins* and *long cut loins.*

The *regular short loin* is the muscular part of the back, above the belly, beneath the fat back and extending from the shoulder to the ham. It includes the slip bone, split vertebrae, back ribs, sometimes part of the scapula, the tenderloin and a small amount of back fat about one-quarter to one-half inch in thickness. Part of the diaphragm (giblets) is frequently attached. They are sold on 8/10, 10/12, 12/14, 14/16 and 16/18 pounds averages. Loins heavier than 18 pounds are called "Extra heavy," those lighter than 8 pounds are termed "Extra light." They are made from butcher, packing and bacon hogs. The loin is the leading pork cut. It is wrapped in paper, muslin or stockinette, packed in crates and boxes, chilled or frozen and sold fresh for roasts and chops. (See Fig. 35).

Loin rolls are heavy loins, boned out, three tied together to form a roll, then sweet pickle cured, smoked and boiled.

The *tenderloin* consisting of the psoas muscles is pulled especially from regular ribs, packed in boxes or tin pails and sold fresh. Weight: $\frac{3}{4}$ to $1\frac{1}{4}$ pounds each.

A *long cut loin* is the short loin and Milwaukee butt in one piece.

Back bones may be sold fresh or rendered for lard.

Bellies include *rib bellies, clear bellies, briskets* and *spare ribs. Full sheet spare ribs* and *belly skins* are also considered.

A rib belly is the lower portion of a rough short rib beneath the fat back and loin and includes the lower part of the ribs (half sheet of

spare ribs), the costal cartilages (feather bones) and breast bones, and are trimmed reasonably square. Weights: 16 to 45 pounds. They are made principally from fat packing and butcher hogs, contain a fair percentage of lean and usually are dry salt cured. (See Fig. 34).

A clear belly is the same as a rib belly except it is free from all bones. They are made from bacon, smooth butcher and light packing hogs, trimmed close, ends squared and free from loose fat. The lighter bellies are sweet pickle cured while the heavier are cured in dry salt mixture. Weight: 6 to 16 pounds, the average being 8 to 12 pounds. Some are quoted as "square cut and seedless." These are made from smooth barrow sides or from sows provided they are cut down to remove all seeds (parenchymatous glandular udder tissue). They are free from bone and fat back tissue and are trimmed square on all edges. (See Fig. 34).

A *brisket* or *brisket end* is the shoulder end of a clear belly about 2 to 4 inches wide and contains the depression of the "fore flank." Weight: 2 to 4 pounds. They are cut from slicing bacon and also to reduce the weight of breakfast bacon bellies. They are cured, smoked and sold as "smoked briskets." (See Fig. 33).

Spareribs are the ribs of pork carcasses. *Half sheet spareribs* are the ribs ends with a portion of the costal cartilages cut from the rib belly or extra short rib. They are trimmed closely as possible and sold fresh and cured. They spoil quickly in warm weather. Dry salt spareribs are those removed from cured cuts. Some cured spareribs are smoked. *Backbone spareribs* refer to the back ribs. *Full sheet spareribs* contain the half sheet and back ribs in one piece. (See Fig. 29).

Belly skins are sometimes used for leather.

(d) Miscellaneous Cuts include some export cuts not already mentioned and barreled pork (see Classes). The bulk of export cuts have a high percentage of lean in proportion to fat and are made from bacon hog carcasses. The export cuts include Wiltshires; *Cumberland, Dublin* and *Birmingham Middles; Long Ribs; Regular* and *Extra Long Clears; Stafford, Yorkshire, Wicklow* and *Stretford Sides; English Bellies; Antwerp Backs* and *Lexington Loins.*

Wiltshire Sides

(*Packers' Encyclopedia*)

Shall be made from nice smooth selected hogs. The shoulder, side and ham left together in one piece. The foreleg to be cut off at or above the knee joint, and the hind leg at or above the hock joint. The shoulder ribs, neckbone, back-

bone, aitch bone, skirt and loose fat to be removed. The breastbone to be sawed, or cut down, even with face of side. Neatly trimmed on belly and squared on the neck.

Cumberland Middles

(Bureau of Agricultural Economics)

A Cumberland middle consists of the side with ham removed. They are cut square on the ham end and front leg is cut off below the knee joint. The shoulder ribs, neck bone, back bone and blood veins are out, and the breast bone is sawed or cut down smooth and even with the face of the side. They are not back strapped or flanked. They are made from good and choice bacon hog carcasses and weigh from 20 to 60 pounds. The bulk, however, are between 25 and 40 pounds. Cumberlands are used extensively for converting into other cuts such as "Yorkshires," "Birminghams," and "Staffords" but this is done principally after arrival at English ports.

Dublin Middle

(Bureau of Agricultural Economics)

This cut is made from light smooth bacon hogs, and consists of the side with ham removed. The sides are relatively thin and comparatively lean. While the quality of the meat is different, the cut is very similar to a Cumberland except the leg is cut off even with the breast. It is made for the English trade.

Birmingham Middle

(Bureau of Agricultural Economics)

A Birmingham middle consists of the side with the ham removed. It has the back bone, ribs and blade bone cut, pocket cut out and nicely rounded, knuckle bone left in and leg cut off close to but not even with the breast. This cut represents only a small percentage of export cuts which are made in this country, they being made principally from Cumberlands, after shipment to England.

Long Rib

(Bureau of Agricultural Economics)

This cut is made the same as the Cumberland, except the shoulder bones are taken out and the leg cut off close to the breast. The end from which the ham was taken is cut square. The neck bone, back bone and blood veins are out and the breast bone sawed or cut down smooth and even with the face of the side. The blade bone is out but the cut is not strapped or flanked. The cuts average 18 to 25 pounds and are made from all grades of bacon hog carcasses and shipped principally to Ireland and Wales.

Regular Long Clear

(Bureau of Agricultural Economics)

This cut consists of the side of a hog carcass with ham removed. The back bone, shoulder bones and ribs are taken out and fore leg cut off close to the breast. The aitch bone and breast bone are sawed off or cut down smooth with the face

of the side. They are not back strapped. For English trade they are made from good bacon hog carcasses and average 18 to 26 pounds. For the continent of Europe heavier carcasses are used and the cuts average 30 to 45 pounds.

(*Permission United States Bureau of Agricultural Economics*)

8/10 average | 10/12 average | 12/14 average

FIG. 35. PORK LOINS

EXTRA LONG CLEAR

(*Bureau of Agricultural Economics*)

These are the same as regular long clears except that the entire loin is taken out. This loin includes the butt of the shoulder and is sold as a long loin. In all other respects, including the closeness of the trim, the two cuts are the same.

Stafford Side

(Bureau of Agricultural Economics)

This cut is very similar to a Birmingham and consists of the side with the ham off. It differs principally from a Birmingham by having the entire loin taken out full to the top of the shoulder blade, leaving only a thin strip of lean along the back. The knuckle is left in and the leg is cut off close to but not even with the breast. This cut is also made extensively from Cumberlands.

Yorkshire Side

(Bureau of Agricultural Economics)

A Yorkshire side consists of the side with ham off and is the same as a Cumberland with the ribs out. This is also an English cut, made principally from Cumberlands after arrival and not made in this country to any appreciable extent.

Wicklow Side

(Bureau of Agricultural Economics)

This cut is the side with ham off, and same as a long rib with pocket. Blade bone is taken out through incision made at the knuckle bone. It too is an English cut and not made generally in this country.

Stretford Side

(Bureau of Agricultural Economics)

This cut consists of the side of hog carcass with ham off. The back bone and half of the ribs are taken out, knuckle in and foot cut off close to, but not even with the breast. It is made from carcasses averaging 140 to 160 pounds. It is made for the English trade.

English Bellies

(Packers' Encyclopedia)

Shall be made from nice smooth sides of barrow hogs, after the back has been removed. Sows may be used, however, provided the seed is cut out, and the width of the belly is in proportion to its length. All edges shall be trimmed square and all bones removed. No scribed cut bellies shall be classed as standard.

Note: Barrow bellies are preferable.

Antwerp Back

(Bureau of Agricultural Economics)

This cut is the same as a Regular Plate except it has the blade bone removed. It is made from the shoulder butt and is usually made when making picnics.

Lexington Loin

(Bureau of Agricultural Economics)

This cut consists of the upper half of a hog carcass, including the entire hindquarter or pork leg and a part of the shoulder all in one piece. The skin including that over the ham but not the leg, is removed.

(3) Classes of Pork Cuts. (a) General. According to trade demand and methods of curing, processing or other preparation, pork cuts may be classified as fresh, cured, cooked and export.

(b) Fresh Pork Cuts are those sold fresh, chilled or frozen (see Trichina rulings under "Trimmings"). Chilled pork cuts are usually consumed within ten days after slaughter during which time they should be held at 32°F., otherwise they are frozen. They include loins, Boston butts, boneless butts, New York shoulders, skinned shoulders, picnics, pork tenderloins, spare ribs, fat backs, pig tails, neck bones, back bones, hocks, feet and other cuts.

(c) Cured Pork Cuts and Meats include *dry salt*, *bacon*, *sweet pickle*, *box cured*, *smoked* and *plain pickle meats.*

Dry salt meats are those of heavier averages cured in dry salt mixture for domestic trade and include the short ribs, regular short and extra clears, loin and fat backs clear and rib bellies, square shoulders, regular and clear plates and jowl butts.

Bacon meats are domestic dry salt meats which have been smoked.

Sweet pickle meats are those cured in sweet pickle. A few are sold as such. Some as loins, picnics and hams after curing, are boned for boiled meats. The majority, however, are cured and then smoked. They include short cut and skinned hams, picnics, New York and skinned shoulders, light bellies, boneless butts, bacon squares and spare ribs. They represent the lighter averages being cut from butcher and the lighter packing hogs.

Box cured meats include light, fancy, well trimmed clear bellies of the best quality cured under pressure in a box using a mild dry cure of salt, saltpetre and sugar.

Smoked meats include the bacon meats and smoked, sweet pickle meats.

Plain pickle meats are fat pieces from the sides and fat backs, cured in brine and barreled for shipment. They include mess pork, back pork, belly pork, shoulder pork and spare ribs.

Standard mess pork is made from rough short ribs of fat hogs, properly flanked but not backstrapped, cut into strips six inches wide, and packed 9 to 16 pieces to a barrel (200 pounds net). "New Mess Pork" is that packed after October of a year and before September 30 of the next, until December 31 of that year when it is known as "Old Mess Pork."

Back pork. Short cut mess or family back pork is made from the rough backs of smooth, heavy hogs with the tenderloin removed. The strips are cut 5 inches wide and packed 20 to 56 or more pieces to the barrel. Clear back pork is made from clear backs, cut into pieces 6

inches wide and packed the same as mess pork. Loin pork is made from regular short loins with the tenderloin pulled, cut into 2 to 4 pieces and packed on end.

Ham butt pork is part of a loin next to a short cut ham, the rump end of a side. It is triangular in shape, consisting of both lean and fat, and is packed 30 or more pieces to the barrel. Fat back pork is made from the short fat backs of heavy hogs, cut 6 inches wide and packed on end, 4 tiers to a barrel which will hold 31 to 85 pieces.

Belly pork is made from light, clear, barrow bellies, cut into 5 inch strips, trimmed square and packed 60 to 70 pieces to a barrel. Brisket pork is made from heavy rib or clear briskets, 5 inches wide, weighing 4 to 5 pounds and packed 60 to 125 pieces to the barrel. Long clear pork is made from extra short ribs, cut 5 inches wide, trimmed square and packed 24 to 30 pieces to the barrel.

Shoulder pork. Shoulder butt pork is made from the rough shoulder butt, the neck trimmed square and flare at the butt end cut off close. Clear shoulder butt pork is shoulder butt pork with the neck bone removed. Boston butt pork is made from Boston butts and is packed 18 to 55 pieces to the barrel. Clear plate pork is made from clear plates and is packed 19 to 60 pieces to the barrel. Plate pork is made from regular plates and packed 18 to 55 pieces to the barrel. Bean pork is cut the same as bacon squares from the jowl and packed 60 to 175 pieces to the barrel. Jowl pork is the same as bean pork except it is trimmed closely on the shoulder side, all loose tissues and blood clots removed, squared and pressed.

Spare ribs, full sheet and half sheet are also barreled.

(d) Cooked Meats refer to the heavier sweet pickled cured pork cuts, boned and fatted and sometimes smoked for cooked meats. They include New York and skinned hams, picnic shoulders, and loins.

(e) Export Meats differ from domestic pork cuts in style of cutting, curing and handling. They are both dry salt and sweet pickle cured before shipment. After arrival in foreign countries these meats are either dried or are given a light smoke.

Dry salt export meats are cured in dry salt and salt petre, then sprinkled with salt and borax and packed in boxes 500 to 550 pounds net. The principal cuts are Wiltshire, Stafford, Yorkshire, Wicklow and Stretford sides; Cumberland, Birmingham and Dublin Middles; long ribs; regular and extra long clears; export clear back; export fat back; Antwerp back; Lexington loin; English belly; three rib shoulder; and, long cut, York, Manchester, Stafford, Bayonne, French, Hamburg and Dutch hams.

Sweet pickle export meats include short cut, sweet pickle cured hams and shoulders, drained, packed in tight barrels and sprinkled with English salt and borax.

(4) Methods of Grading Pork Cuts. (a) General. The methods of grading pork cuts are very complex. The points which influence grading are the class, breed, type and sex of the carcass; the shape, quality, thickness, finish and average weights of the cuts; the proportion of lean and fat; soundness, sales policy, demand, styles of cutting and methods of packing. Finish refers to the depth and evenness of fat. Boar cuts would be excluded on post-mortem examination for sexual odors. The desired points of quality are a solid, firm, white fat; firm, bright, smooth grained flesh of good texture and not watery; a smooth, thin, mellow skin free from wrinkles, hardness, blotches, bruises, "dug outs" and cuts; moderately small, fine, soft red bones; and a general absence of coarseness. The three most important points to be considered are quality, thickness and weight. Pork cuts are graded out on the cutting floor and are trimmed accordingly.

Pork cuts coming from carcasses of hogs which have not received the required Army Veterinary ante-mortem and post-mortem examination as required by regulations, or those not bearing the inspection legend of an approved sanitary official inspection agency, or whose subsequent handling has been questionable and those unsound, would be graded as "No Grade."

(b) Hams. Usually three grades of short cut hams are made according to their adaptability for smoked hams, as follows, Fancy or No. 1, No. 2 and No. 3. (See Fig. 28).

The highest grade should have a plump, full, well rounded shape extending toward the hocks; thick, firm, bright colored lean meat free from flabbiness, tears, bruises and cuts on the face; solid, firm, white bright colored fat of medium thickness (not over 2 inches thick); smooth, soft, thin, bright colored skin, free from wrinkles, tears, bruises, cuts or other defects; relatively small shank; sound; and showing evidence of prior official inspection. Stag hams would be too coarse and heavy for Fancy hams. Usually no difference in grading exists for barrow and sow hams. Hams from male animals are told by the "pizzle eye." No. 1 hams are graded by weight into 8, 10, 12, 14 and 16 pound averages and sometimes into 16, 18 and 20 pound averages with a spread of 2 pounds each way. No. 1 hams usually are made from butcher hogs. No. 2 or second grade hams have slight deficiencies in many of the above respects or a marked deficiency in some. Hams too fat for No. 1 grade are frequently placed into No. 2. Many skinned

hams fall in this grade. Skinned hams have the following weight averages: 12/14, 14/16, 16/18, 18/20, 20/22, and 22/24 pounds.

No. 3 hams are too deficient for use in the regular market trade. They may lack shape and quality, some are thin and light. Hams with skin cuts or dug outs where the lean is exposed, and those from stags would come under this grade.

(Permission United States Bureau of Agricultural Economics)

D. S. rib back D. S. fat back

FIG. 36. PORK CUTS

"No Grade" hams are explained above.

(c) Loins. Regular short cut loins are graded as No. 1, No. 2 and "No Grade," also according to weight.

No. 1 loins should have good shape, high quality and should not be too heavy. Such loins should be bright in color, with firm fine grained meat and good quality of bone.

No. 2 loins include those with dark colored, coarse flesh, coarse bones, also heavy or very light loins.

Loins are principally graded according to weight in the following averages: 8/10, 10/12, 12/14, 14/16, 16/18 pounds, extra heavy over 18 pounds and extra light under 8 pounds. The price of loins is in inverse ratio to the weight. (See Fig. 35).

"No Grade" loins are explained above.

(d) Bellies. There is a greater variation in the grades of bellies than for any other pork cut. They may be graded out according to type, weight, appearance, condition, sex, shape, finish, quality, soundness, sales policy, demand, and according to cure, as dry salt, sweet pickle, breakfast bacon and English bellies.

Stag bellies are undesirable as they are large and coarse, with thick, wrinkled skin and a high colored, coarse flesh. Sow bellies may or may not be desirable according to age of the animal, weight and breeding. Sow bellies may show different kinds and amounts of seeds (lobules of mammary glands and associated pigment). The parenchymatous mammary substance is undeveloped in the gilt. After pregnancy this tissue develops and is white in color (white seeds). In advanced pregnancy it is in abundance (seedy belly). After pregnancy its color may vary from a pale pink to a deep red (red seeds). Black pigmentation ensues. Seedy belly or the presence of red or black seeds are undesirable in bellies. Frequently the udders of sows are diseased or abscessed. Barrow bellies are more desirable than sows, and are told practically by the presence of an extra streak of lean, said to be the retractor penis muscle. They are the least wasteful of bellies and have the highest average degree of quality.

Bellies under the above designations may be graded out as No. 1, No. 2, No. 3 and "No Grade." (See Fig. 50).

No. 1 bellies should be of the highest desirable quality, type and of the lighter averages. They should be comparatively lean, firm, of a good color, with a smooth, thin skin, and free from defects. No. 1 bellies for box cure are graded out in averages as follows: 4/6, 6/8, 8/10 and 10/12 pounds. Regular bellies are graded out in the following averages: 6/8, 8/10, 10/12, 12/14 and 14/16 pounds.

No. 2 bellies are deficient in some respects, frequently too fat and lacking in firmness of flesh or smoothness of skin.

No. 3 bellies are too deficient for No. 2, some having dug outs, tears, wrinkled, thick skin or other like defects in quality.

"No Grade" bellies are explained above.

(e) Picnics are graded out according to the general points described above. Stag picnics are heavy and coarse. Picnic shoulders are

graded in the following averages: 4/6, 6/8, 8/10 and 10/12 pounds. (See description of picnics.)

(5) Commercial data.

PERCENTAGE OF CUTS FOR DOMESTIC TRADE BASED ON CARCASS WEIGHT INCLUDING HEAD, FEET AND LEAF FAT

(Bureau of Agricultural Economics)

CUT	RANGE OF PERCENTAGE	AVERAGE PERCENTAGE
Hams	15–17	16
Bellies	15–17	16
Shoulders	15–17	16
Loins	13–15	14
Backs	9–11	10
Leaf Fat	4–6	5
Head	6–8	7
Lean Trimmings	3–5	3½
Fat Trimmings	12–13	12½

	PERCENTAGE OF LIVE WEIGHT	PERCENTAGE OF COLD DRESSED WEIGHT
Short Cut Hams	14.0	19.5
Long Cut Hams	18.0	26.5
Skinned Hams	12.0	16.5
Italian Hams	14.0	19.5
Skinned Shoulders	10.0	14.0
New York Shoulders	13.0	18.5
New Orleans Shoulders	12.0	17.0
Picnic Shoulders	5.5	7.5
Boston Butts	4.0	5.5
Boneless Butts	2.0	3.0
Regular Plates	5.0	6.5
Clear Plates	2.7	4.0
Neck Fats	3.5	4.5
Short Ribs	36.0	50.0
Short Clears	32.0	44.0
Short Cut Backs, Regular	18.0	24.0
Short Cut Backs, Narrow	14.0	20.0
Sweet Pickled Bellies, Regular	12.5	17.5
Sweet Pickled Bellies, Wide	14.0	19.5
Dry Salt Bellies, Regular	14.5	21.0
Dry Salt Bellies, Wide	18.0	26.5
Dry Salt Extras	25.0	35.5
Fat Backs, Narrow	6.0	8.5
Fat Backs, Regular	11.0	15.0
Pork Loins	9.0	13.0
Spare Ribs, Full sheet	2.0	3.0

Most packers figure the yields of cuts both on the weight of the live animal and on the cold dressed weight without head, leaf and facings. Packing hog carcasses without head, in coolers at temperatures from 32 to 40°F., will shrink from 1.75 to 2.40 per cent from hot to cold weight. Higher temperatures or refrigeration troubles will increase the shrinkage.

The average percentage of various pork cuts based on both the live weight and cold dressed weight, without heads, leaf fat and facings, are shown in the tables on page 223. These percentages include practically all cuts which are made regularly at packing centers.

The percentages of different cuts for English trade based on the live weight are as follows:

Cut	*Percentage*
Long Cut Hams	$17\frac{1}{2}$–18
Manchester Hams	16
Cumberlands	38–40
English Square Cut Shoulders	14–15
Short Ribs	23–24
Wiltshires	57–60
Dublins	35
Long Rib	35–36

WEIGHT OF PORK CUTS COMPARED TO CARCASS WEIGHTS

(*Morris and Company*)

		REGULAR HAM	SKINNED HAM	D. S. TRIM RIB BELLY	D. S. TRIM CLEAR BELLY	MATCHLESS BELLY	SUPREME BELLY	ROUGH RIB BACK	FAT BACK	PORK LOIN
	lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
Hogs	90/140	10/14	9/12	10/14	8/12	6/10	4/8	12/20	5/8	7/9
Hogs	150/190	15/18	13/16	16/20	14/18	11/15	8/12	21/26	10/12	10/14
Hogs	190/225	18/22	16/18	20/24	18/22	15/17	12/14	26/35	12/16	14/16

		NEW YORK SHOULDER	PICNIC OR CALA	JOWL	SPECIAL SQUARE	BOSTON BUTT	CLEAR PLATE	SPARE RIB	NECK BONE
	lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
Hogs	90/140	9/14	4/6	2/3	$\frac{3}{4}/1\frac{1}{2}$	3/4	1/2	$1/1\frac{1}{4}$	$\frac{1}{2}/\frac{3}{4}$
Hogs	150/190	14/18	6/8	3/4	$1\frac{1}{2}/2\frac{1}{4}$	4/5	$2\frac{1}{4}/3\frac{1}{2}$	$1\frac{1}{4}/1\frac{3}{4}$	$\frac{3}{4}/1$
Hogs	190/225	18/22	8/10	4/5	$2\frac{1}{4}/3$	5/6	$3\frac{1}{2}/4\frac{1}{2}$	$1\frac{3}{4}/2$	$1/1\frac{1}{4}$

Weight Ranges of Green, Sweet Pickled and Dry Salt Meats
(Packers' Encyclopedia)

NO PIECE LIGHTER THAN	AVERAGE	NO PIECE HEAVIER THAN
pounds	*pounds*	*pounds*
3	4	5
4	5	6
5	6	7
6	7	8
6	8	10
7	9	11
8	10	12
9	11	13
9	12	15
10	13	16
11	14	17
11	15	19
12	16	20
13	17	21
14	18	22
15	9	23
6	20	24
6	21	26
17	22	27
18	23	28
19	24	29
20	25	30
21	26	3
22	27	32
23	28	33
24	29	34
25	30	35
25	31	37
26	32	38
27	33	39
27	34	41
28	35	42
29	36	43
29	37	45
30	38	46
31	39	47
32	40	48
33	41	49

It is understood that the above range is the limit from the actual average of the lot delivered.

(6) Army Requirements. The selection of fresh pork cuts for Army bacon and other cured products is covered in Chapter IX. The sanitary requirements of the Surgeon General are covered in Army Regulations and under Veterinary examinations, this chapter. Reference should be made to War Department purchase specifications for fresh pork provided it is purchased under the Quartermaster General.

All cuts purchased fresh for the Army should be of the best quality from recently slaughtered animals in prime condition and sound. Cuts from old sows, stags, or boars, and those too fat, coarse, oily or not within the weight limits should not be accepted. They should be prepared, handled and packed in a sanitary manner in accordance with requirements.

d. Pork Trimmings. (1) General. In cutting and trimming pork cuts many scraps of tissue result. The inedible scraps are made into white grease. The fat trimmings, called "cutting" fat, are sent to the lard department. Pieces containing lean meat, known as "trimmings" are further trimmed from fat. Trimmings while obtained from all parts of the carcass, usually are named according to the part from which they are trimmed; as, fat back, ham, belly and neck bone trimmings. Neck bone trimmings frequently contain particles of bone; and belly trimmings, seeds.

(2) Grades. There are four general grades of pork trimmings: No. 1, No. 2, No. 3 and No. 4.

(a) No. 1 or "Regular" pork trimmings, also called "B" trimmings, are of miscellaneous shape, size and quality. Usually they are in small pieces containing 40 to 60 per cent of fat. They are sometimes called "Fat" trimmings.

(b) No. 2 or "Fat back" pork trimmings are also known as "C" trimmings.

(c) No. 3 trimmings are also known as Special Lean, Extra Lean, Berliner or "A" pork trimmings. They are larger than No. 1 with a low percentage of fat (10 to 30 per cent) being cut principally from hams and shoulders.

(d) No. 4 trimmings, also called "Mortadella Meat," and "Diamond X" pork trimmings, are extra lean pieces cut from hams.

Trimmings are utilized, fresh or cured, in the manufacture of sausage. If stored too long in a damp cooler, trimmings become slimy. To hold any length of time they are frozen in boxes of about 100 pounds net. For sausage they may be dry cured. In shipping fresh trimmings they are chilled, and packed in barrels. During warm weather a slatted

tube, 6 inches in diameter and bound with wire, may be placed through the center of the barrel, then filled with cracked ice to aid preservation.

(3) Trichinella spiralis. Inasmuch as it cannot be determined definitely by any present known method of inspection whether muscle tissue of swine contains trichinae which are dangerous to health, no article of a kind customarily eaten without cooking should contain pork muscle unless it has been refrigerated, or heated or subjected to such other treatment as will destroy all live trichinae, approved as follows:

(a) Freezing. Fresh pork or the articles of which it is an ingredient after preliminary chilling or freezing should be stored in freezers 20 successive days at a temperature not exceeding 5°F.; provided, they are arranged on racks in layers not exceeding 6 inches in thickness, or hung in separate pieces, or packed in small containers as boxes not over 6 inches in depth, or stored as frozen blocks after their removal from such containers. They should be stored or arranged loosely in such a manner as will insure free air circulation between the pieces or containers and thus facilitate the prompt reduction of the temperature of the meat to that of the freezer.

When stored in large containers as tierces or barrels it is necessary to freeze the pork thirty successive days at a temperature not exceeding 5°F. to make a ten-day allowance of time for the temperature of the meat in the center of the container to drop to the required temperature.

During such refrigeration the pork should be kept separate from all other meats in compartments and securely locked under veterinary supervision. Standard thermometers should be used to indicate temperatures being placed in the freezers at or above the highest level of the meat. The accuracy of these thermometers should be checked by comparison to standardized thermometers furnished for that purpose. Inspectors should make frequent temperature and sanitary observations during such storage.

(b) Heating. An alternative method is that of subjecting fresh pork to heat so that all portions attain a temperature not lower than 137°F. Naturally larger pieces of meat will require a longer heating than smaller pieces.

(c) Curing and other Approved Methods (Modified after United States Bureau of Animal Industry Requirements):

Sausage Method No. 1

Pork trimmings shall be chopped or ground into pieces not exceeding ¾ inch in thickness and thoroughly mixed with a dry curing mixture of not less than

$3\frac{1}{3}$ pounds of salt to each hundred weight of unstuffed sausage, then held in a drying room not less than twenty days at a temperature not lower than 45°F., except in case of pepperoni stuffed in hog or sheep casings not exceeding $1\frac{3}{8}$ inches in diameter at time of stuffing, when the period of drying may be reduced to fifteen days. However, the sausage shall not be released from the drying room in less than twenty-five days from the time the curing materials are added except pepperoni as specified above may be released after twenty days from the time the curing materials are added.

Sausage Method No. 2

Pork trimmings shall be chopped or ground into pieces not exceeding $\frac{3}{4}$ inch in thickness and thoroughly mixed with a dry curing mixture of not less than $3\frac{1}{3}$ pounds of salt to each hundredweight of unstuffed sausage, then smoked at least forty hours at 80°F., or above and finally held in a drying room for at least ten days at not less than 45°F. However, the sausage shall not be released from the drying room in less than eighteen days from the time the curing materials are added.

Sausage Method No. 3

Pork trimmings shall be chopped or ground into pieces not exceeding $\frac{3}{4}$ inch in thickness and thoroughly mixed with a dry curing mixture of not less than $3\frac{1}{3}$ pounds of salt to each hundredweight of unstuffed sausage, then before stuffing this meat shall be held at a temperature not lower than 34°F. for at least thirty-six hours. After stuffing, the sausage shall be held not lower than 34°F., for an additional period of time to make a total of at least one hundred and forty-four hours, or 6 days from the time the curing materials were added. Finally the sausage shall be smoked for not less than twelve hours in a smoke-house provided with an accurate recording thermometer. At no time during this smoking shall the temperature be less than 90°F., and for four consecutive hours the temperature must be maintained not lower than 128°F. Not less than four hours should be occupied in raising the temperature from 90°F. to 128°F., after the sausage has been placed into the smoke-house.

Hams, Method No. 1

The hams shall be cured by a dry-curing process not less than forty days at a temperature not lower than 36°F. The hams shall be laid down in salt, not less than 4 pounds to each hundredweight of hams, the salt being applied in a thorough manner to the lean meat of each ham. When placed in cure the hams may be pumped with pickle if desired. At least once during the curing process the hams shall be overhauled and additional salt applied, if necessary, so that the lean meat of each ham is thoroughly covered.

After removal from cure the hams may be soaked in water at a temperature not higher than 70°F. for not more than 15 hours, during which time the water may be changed once; but they shall not be subjected to any other treatment designed to remove salt from the meat, except that superficial washing may be allowed. The hams shall finally be pale dried or smoked not less than ten days at a temperature not lower than 95°F.

Hams, Method No. 2

The hams shall be cured by a dry-curing process at a temperature not lower than 36°F. for a period of not less than three days for each pound of weight (green) of the individual hams, calculating the time of cure of each lot of hams placed in cure upon a basis of the weight of the heaviest ham of the lot. Hams cured by this method before they are placed in cure shall be injected with pickle containing not less than 25 per cent of salt, about 4 ounces of the solution being injected into the shank and a like quantity along the flank side of the body bone. The hams shall be laid down in salt, not less than 4 pounds of salt to each hundredweight of hams, the salt being applied in a thorough manner to the lean meat of each ham. At least once during the curing process the hams shall be overhauled and additional salt applied, if necessary, so that the lean meat of each ham is thoroughly covered. After removal from cure the hams may be soaked in water at a temperature not higher than 70°F. for not more than 4 hours, but shall not be subjected to any other treatment designed to remove salt from the meat, except that superficial washing may be allowed. The hams shall then be pale dried or smoked not less than 48 hours at a temperature not lower than 80°F. and finally shall be held in a drying room not less than twenty days at a temperature not lower than 45°F.

Capacola (Capicola, Capocollo)

Boneless pork butts for capacola shall be cured in a dry-curing mixture containing not less than 4½ pounds of salt per hundredweight of meat for a period of not less than twenty-five days at a temperature not lower than 36°F. If the curing mixture is applied to the butts by the process known as churning a small quantity of pickle may be added. During the curing period the butts may be overhauled according to any of the usual processes of overhauling, including the addition of pickle or dry salt if desired. The butts shall not be subjected during or after curing to any treatment designed to remove salt from the meat, except that superficial washing may be allowed. After stuffing, the product shall be smoked for a period of not less than thirty hours at a temperature not lower than 80°F., and shall finally be held in a drying room not less than twenty days at a temperature not lower than 45°F.

Coppa

Boneless pork butts for coppa shall be cured in a dry-curing mixture containing not less than 4½ pounds of salt per hundred-weight of meat for a period of not less than eighteen days at a temperature not lower than 36°F. If the curing mixture is applied to the butts by the process known as churning a small quantity of pickle may be added. During the curing period the butts may be overhauled according to any of the usual processes of overhauling, including the addition of pickle or dry salt if desired. The butts shall not be subjected during or after curing to any treatment designed to remove salt from the meat, except that superficial washing may be allowed. After stuffing, the product shall be held in a drying room not less than thirty-five days at a temperature not lower than 45°F.

Under the above rulings come all forms of summer sausages containing pork, also mortadella, mettwurst, Italian style hams, Westphalia style hams, loin rolls, pork butts for capacola and coppa, and pork or pork and beef which has been chopped, seasoned, stuffed in cloth containers, dried and sometimes smoked.

(d) Summary from United States Department of Agriculture Bulletin 880, "Effects of Pork-Curing Processes on Trichinae."

Pork products of kinds customarily eaten without cooking may be rendered safe for consumption, so far as the dangers of trichinosis are concerned, by certain curing processes. No single formula can be applied to all such products, as different ones require different treatments, depending largely on their size and on whether they are smoked.

Sausages of moderate sizes have been rendered innocuous by the admixture of salt to the meat (not less than 3⅓ pounds of salt per hundred-weight of meat) followed by preliminary curing and then by drying. A minimum period of twenty-five days for the duration of these processes from the time the salt is added to the meat has been adopted as meeting the requirements for the destruction of trichinae in unsmoked sausage. Of the twenty-five days at least twenty days must be devoted to drying at temperatures not lower than 45°F. Thus, a period of five days is allowed for preliminary curing, which may be curtailed, however, provided the time in the drying room is correspondingly increased.

In the case of certain sausages known as pepperoni, which are stuffed in narrow, thin casings, it was found feasible to reduce the curing period to twenty days, of which at least fifteen days must be given to drying. This allows five days for preliminary curing, which may be curtailed provided the time in the drying room is correspondingly increased.

In the case of smoked sausage it was found feasible to reduce still further the drying period. This variety of sausage is rendered innocuous by being subjected to a preliminary cure and then smoked at temperatures ranging around 80°F. for forty hours followed by drying for ten days at temperatures not lower than 45°F. Including the preliminary curing period, the sausage is held under supervision for eighteen days from the time the salt is added to the meat. Sausage smoked at temperatures ranging from 125° to 130°F. for a relatively brief period following a preliminary curing period of at least six days is rendered innocuous without subsequent drying. Specifically the smoking period lasts twelve hours, of which four hours are devoted to bringing the temperature up gradually to at least 128°F. During the next four hours the temperature is maintained at 128°F. or higher, and during the remaining four hours it is allowed to go down gradually to a point not below 90°F.

Sausage smoked for six hours at a temperature of about 100°F. followed by ten days of drying was not rendered innocuous. This procedure is accordingly not recognized by the bureau as meeting requirements for the destruction of trichinae in sausage.

Hams are rendered innocuous by the following methods: (1) The products are cured by means of dry salt (4 pounds of salt per hundredweight of meat) for at least forty days at a temperature not lower than 36°F., and then smoked

or pale-dried for ten days at a temperature not lower than 95°F.; or (2) the products are cured on the basis of three days' cure for each pound of weight of individual hams, followed by forty-eight hours of smoking at a temperature not lower than 80°F. and finally by twenty days' drying at a temperature not lower than 45°F.

Products known as coppa are rendered innocuous by dry-salt curing for eighteen days (4½ pounds of salt per hundredweight of meat with the addition of small quantities of pickle solution) at temperatures not lower than 36°F. followed by drying for at least thirty-five days at a temperature not lower than 45°F.

Products known as capicola are rendered innocuous by twenty-five days of curing under conditions similar to those used in preparing coppa, followed by twenty hours of smoking at a temperature not lower than 80°F., and finally by twenty days' drying at a temperature not lower than 45°F.

No method has yet been discovered for rendering lockschinken innocuous by means of curing without affecting the quality of the product.

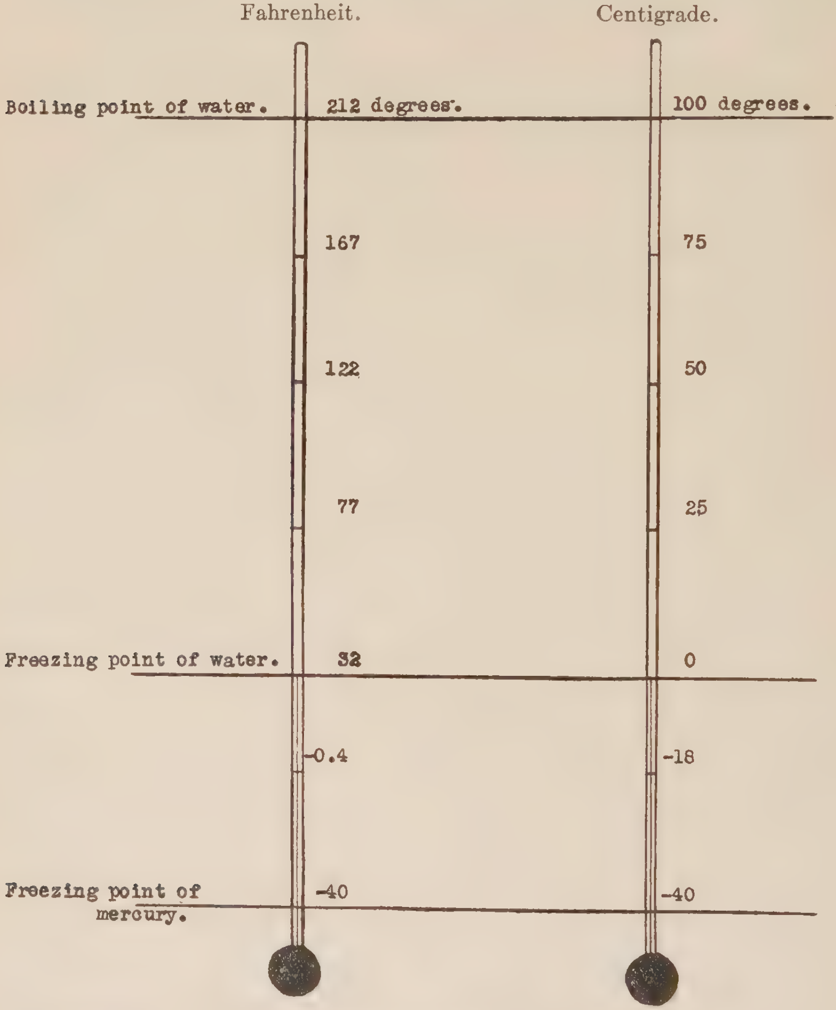
The factors which appear to exert injurious influences on trichinae in the course of curing are salt and temperature. The former gradually undermines the vitality of the parasites, probably by withdrawing water from their tissues and also perhaps by exerting upon them a direct toxic action. Salt furthermore lowers the resistance of the larvae to heat and thus renders them susceptible to temperatures which normally would not prove fatal. The temperatures employed during smoking or pale-drying in most of these experiments were by themselves too low to injure seriously the parasites, but the combined action of salt and temperature was efficacious in destroying the vitality of the larvae.

Drying is also a decided factor in bringing about the destruction of trichinae, apparently because the evaporation of moisture from the meat increases the concentration of the salt in addition to other possible injurious effects it may exert.

6. Cold Storage of Fresh Meats. a. General. (1) Refrigeration, Defined. Fresh meats may be preserved by desiccation, heat sterilization, condimental antiseptics and low temperatures. The first three methods are covered under prepared products, the last method is described herein. Refrigeration is the extraction of heat from a body, cooling it to a temperature below surrounding substances. Refrigeration may be natural as caused by climatic conditions or the melting of ice, and artificial as produced by mechanical means. Refrigeration is used in cold storage places to cool stored commodities, to absorb heat generated in the rooms, to offset losses through ventilation and to absorb heat transmitted through walls and insulation.

(2) Heat. Heat is the energy of molecular or atomic vibratory motion and is not a substance. Potential or latent heat is that which is stored up in a substance or released during a change from one physical state to another, as from ice (solid) to water (liquid) or from water

to steam (vapor). The former is called the latent heat of fusion and the later the latent heat of evaporation. Sensible heat is that which



To change F. to C.: first subtract 32, multiply by 5 and divide by 9.
To change C. to F.: multiply by 9, divide by 5, then add 32.

Fig. 37. Comparison of Fahrenheit and Centigrade Temperature Scales

causes a substance to expand. The extraction of heat causes a reduction of temperature, decrease of volume (except water) and a physical change from vapor to a liquid or from a liquid to a solid.

Temperature indicates the degree of the intensity of heat. When there is no vibration of molecules, there is no heat. This point is the absolute zero of temperature, 459.6° below zero F. The unit of sensible heat or temperature measurement is the degree. In measuring temperatures in cold storage rooms in the United States, the Fahrenheit thermometer scale is used almost exclusively. The bases are the boiling and freezing points of water, and the contraction or expansion of mercury in a capillary, glass tube is noted on a scale between base points. In the Fahrenheit thermometer there are 180 divisions or degrees between the two bases. The freezing point is placed at 32 and the boiling point at 212. On the centigrade (centum, one hundred—gradus, degree) scale there are 100 degrees between the bases. The freezing point is placed at zero and the boiling point at 100.

(3) Units of Refrigeration. The heat required to lower or to increase the temperature of one pound of water, 1°F. (between 32 and 33°F.) is used in America as the unit of heat and is known as the "British thermal unit" (B.t.u.). It is equivalent to 778 foot pounds.

The specific heat of a substance is the quantity of heat expressed in B.t.u. required to lower or to raise the temperature of one pound of the substance 1°F.

When ice melts in a cold storage box, 144 B.t.u. per pound are required to produce the melting (latent heat of liquefaction).

The commercial unit (standard commercial ton) of refrigeration is the quantity of heat required to melt 2000 pounds or one ton of pure solid ice into water at the freezing point, thus extracting 288,000 B.t.u. from the surrounding media. The standard commercial ton of refrigeration is the practical basis for all artificial refrigeration.

The refrigeration power is the rate of performing refrigeration. It is the production of refrigeration at the rate of 1 standard ton of 288,000 B.t.u. per twenty-four hours day. This is computed by dividing the total heat transferred in one day by 288,000.

One ton of refrigeration is equal to 288,000 B.t.u. per day, 12,000 per hour, 200 per minute or 3.3 per second.

(4) Refrigerating Load. (a) General. In order to produce the amount of refrigeration necessary to cool stored products, to absorb heat generated in rooms, to offset losses through ventilation and to absorb heat transmitted through walls and insulation, calculations can be made to determine the refrigerating load.

(b) Cooling Stored Products. The amount of heat extracted from fresh meats placed into cold storage, depends upon their temperature

at entry, weight, specific heat, state of initial condition whether chilled or frozen, and the final temperature to be attained in the storage place. In freezing meats, the temperature is lowered to the freezing point, the latent heat of fusion is removed, then the temperature is reduced to that of the room. To determine in B.t.u. the amount of sensible heat to be removed in cooling meats, multiply the weight of the meat in pounds by the number of degrees to be cooled and this by the specific heat. If frozen, the latent heat of fusion is also added. Reference may be made to the following table:

NAME	SPECIFIC HEAT BEFORE FREEZING	SPECIFIC HEAT AFTER FREEZING	LATENT HEAT OF FUSION
	B.t.u. per pound	*B.t.u. per pound*	*B.t.u. per pound*
Beef, lean	0.77	0.41	102
Beef, fat	0.60	0.34	72
Mutton, chilling	0.81	0.67	100
Pork, chilling	0.51	0.30	55
Veal	0.70	0.39	90

The refrigeration required to cool a 125 pound quarter of beef from 38°F. to 10° below zero F. may be considered.

The initial temperature of the beef is 38°. The specific heat above the freezing point (28°F.) is 0.77 B.t.u. per pound. The latent heat of fusion is 102 B.t.u. per pound. The specific heat after freezing is 0.41 B.t.u. per pound. Therefore the problem may be stated as follows:

		B. t. u.
Reduction from 38°F. to 28°F.	$125 \times 10 \times 0.77$ B.t.u. =	962.50
Freezing (latent heat of fusion)	125×102 B.t.u. =	12,750.00
Reduction (28°F. to 10° below zero F.)	$125 \times 38 \times 0.41$ B.t.u. =	1,947.50
Total		15,660.00

(c) Heat Generated in Rooms. For each watt capacity in electric lights, 3.41 B.t.u. are allowed, for each workman 500 B.t.u. per hour.

(d) Refrigerating losses through ventilation depend on the size and temperature of the room, and the temperature and humidity of the incoming air. For ordinary conditions, 2 to 3 B.t.u. per cubic foot of incoming air are allowed.

(e) Heat Transmission. The amount of heat transmission through walls depends on the kind and thickness of insulation, wall surface area in square feet and the difference between the outside and room temperatures and is found by multiplying together the wall area in

square feet, the number of degrees F. difference between the outside and inside temperatures and the heat transfer coefficient.

b. Production of Refrigeration. (1) General. The principle of most elementary and modern refrigerating devices depends upon the fact that heat (latent heat) is absorbed in considerable quantities when a solid melts or a fluid is evaporated. This heat is removed from surrounding objects which become correspondingly cold.

(2) Natural Refrigeration. Since earliest times, fresh meats have been preserved by climatic conditions in cold climates. In warmer, dry climates, fluids were also cooled below atmospheric temperatures through the evaporation of a part of the liquid to be cooled, by putting it into porous vessels which were then hung in a current of cool, circulating air. This principle is used today as in the South African water bag and in wrapping wet cloths around cans of milk. Other methods consisted of cooling products in containers in cold water, running streams, caves, or cellars where the temperature would average 50 to 60°F. Freezing mixtures of snow, ice or water and salt petre, and snow and salt, have been used for ages.

Natural ice has been used a long time. It is harvested in the Winter and stored in caves or in ice houses packed with ground cork or sawdust. Artificial ice is now used extensively. The average consumption in the United States is about 1000 pounds per person per annum. Ice is used in ice boxes, different types of refrigerators and in freezing mixtures used to cool retail storage rooms.

To cool objects placed into a closed insulated box for storage, a quantity of ice is first introduced. The ice provides a medium which absorbs heat from the stored materials and from the compartment. In melting, the ice absorbs this heat as its latent heat of fusion. The medium with its load of heat is then removed from the cooler. Reicing of the box provides a means for the continued cooling of the compartment by the removal of heat. Heat always flows from a warmer body to a colder body, the principle being the heat transfer by temperature equalization. Where there is no difference in temperature there is no heat transfer.

Ice which melts at a constant temperature of 32°F. under atmospheric pressure, requires 144 B.t.u. per pound for its latent heat of fusion. The melting of one ton of ice is equivalent to the removal of 288,000 B.t.u. of heat. (The exact latent heat of fusion of ice is 143.5 B.t.u. per pound, although 144 B.t.u. per pound is generally adopted as a standard.)

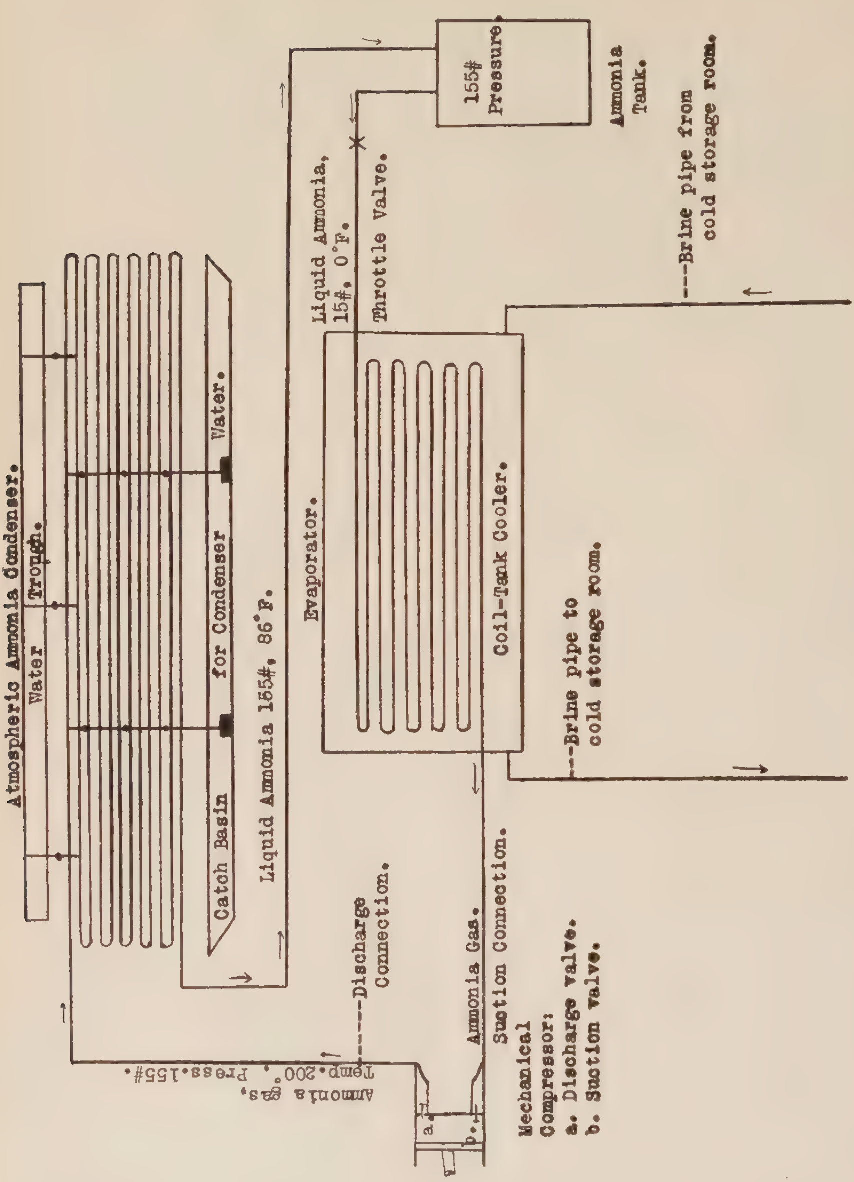


FIG. 38. ELEMENTARY COMPRESSION SYSTEM
(With Atmospheric Ammonia Condenser, Ammonia Tank and Coil-Tank Cooler with Indirect Brine System)

The first application of natural ice for a cooling effect was that of placing products in contact with the ice. Goods became saturated and due to poor air circulation, mouldy. Next a separation of the goods from the ice was made. Later, improved ice cold storage systems contained overhead ice storage, good air circulation and auxiliary brine tanks. One modern system contains an overhead tank with primary brine coils in connection with secondary brine coils in the cold storage room. This closed pipe system contains brine which is cooled in the tank filled with crushed ice and salt. The cold brine then gravitates into the lower cold storage room while the warmer brine rises to the primary coils to be cooled.

(3) Artificial Refrigeration. (a) General. A substance which absorbs heat from materials to be cooled, is called a refrigerant or a refrigerating medium. According to the manner of heat absorption, refrigerating media are classified into 3 groups:

Those which refrigerate by the absorption of their sensible heats include air and brines.

Liquefiable vapors cool materials by the absorption of their latent heats of evaporation and include ammonia, sulphur and carbon dioxides, methyl and ethyl chlorides, etc.

Aqua ammonia is a solution which carries a liquefiable vapor.

(b) Sensible Heat Refrigerants. *Air*. Refrigeration may be produced by the expansion of air. If compressed air at 60°F. under 10 inches pressure were blown from a jet into a room under ordinary pressure, the sudden expansion of this air, thoretically would reduce the temperature to 13.3°F. below freezing.

Compressed air refrigeration is used frequently on ships and in mobile cold storage trucks. The atmospheric air is mechanically compressed to a high pressure, cooled by water and expanded into the cold storage room. When compressed, air gives off heat, when released from pressure it absorbs heat. Usually this type of refrigeration is uneconomical (also see "Forced Air Circulation Methods").

Brines. Brine as a refrigerating agent for temperatures above freezing is quite generally employed. The brine which is used is either sodium chloride or calcium chloride in an aqueous solution.

Aqueous Solutions of Sodium Chloride
(*Refrigeration Memoranda—Levey*)

PER CENT SALT BY WEIGHT	SALOMETER DEGREES 60°F.	SPECIFIC HEAT	WEIGHT 1 CUBIC FOOT	FREEZING POINT DEGREES F.
0	0	1.0	62.4	32.0
1	4	0.992	62.8	31.8
5	20	0.96	64.7	25.4
10	40	0.892	66.95	18.6
15	60	0.855	69.57	12.2
20	80	0.829	71.76	6.86
25	100	0.783	74.26	1.00

Aqueous Solutions of Calcium Chloride
(*Refrigeration Memoranda—Levey*)

SPECIFIC GRAVITY	SPECIFIC HEAT AT 68°F.	PER GALLON SOLUTION	FREEZING POINT DEGREES F.
		pounds	
1.250	0.670	3.76	−32.6
1.225	0.685	3.36	−19.5
1.200	0.704	2.95	−8.7
1.175	0.725	2.56	Zero
1.150	0.757	2.18	+7.5
1.125	0.787	1.80	+13.3
1.100	0.823	1.43	+18.5

Brine for refrigeration is cooled (see "Brine Coolers") and the cold brine is pumped through coils or other devices located in the rooms to be cooled (see "Brine Circulating Systems"). Sodium chloride brine can be used where the temperature to be maintained is 6°F. or above and where the coil tank cooler is used. In the double or triple pipe cooler it cannot be used as it freezes readily. Calcium chloride brine can be used for lower temperatures and can be cooled in the double or triple pipe cooler.

(c) Liquefiable Vapor Refrigerants. *Ammonia.* About 95 per cent of all mechanical refrigeration in the United States is produced by the use of ammonia (NH_3). It is a colorless liquid, weighing 38.45 pounds per cubic foot. There are about 100 to 115 pounds of ammonia to a drum. It has no corrosive action on steel or iron, but attacks copper and certain alloys. Under atmospheric pressure, ammonia boils at −27°F. Ammonia may be liquefied under great pressure while its temperature is kept very low. When the liquid ammonia is allowed to evaporate under low pressure, refrigeration is produced by the

disappearance of the latent heat of evaporation. A refrigerant as ammonia must have a boiling point so low that it will absorb heat at refrigerating temperatures. One pound of liquid ammonia at −27°F. under atmospheric pressure, will absorb 592.5 B.t.u.

Compression System of Refrigeration. The compression system consists of four essential parts, the compressor, the condenser, the throttle valve and the evaporator. A liquefiable refrigerant as ammonia is employed. For example, in the compressor the ammonia gas is put under high pressure (155 pounds). A high temperature results. This gas is then forced into the condenser. The condenser is a series of pipe coils over which cold water constantly flows. The cold water absorbs heat from the condenser pipes containing the hot gas, cooling the ammonia (to about 86°F.) which changes to a liquid condition. The liquid ammonia may be stored in a holding tank or immediately forced through a throttling (regulating) valve where the pressure is reduced to about 15 pounds and the temperature to about 0°F. The liquid ammonia now flows into the evaporator (as direct expansion coils in a cold storage room) where it is evaporated. In this process it absorbs its latent heat of evaporation from the stored materials. The ammonia gas is now drawn by the suction of the compressor pump back into the compressor to be used over again.

Refrigerating plants are always rated in tons capacity, i.e., a certain number of tons of refrigeration per day of twenty-fours. A machine is rated in tons of ice melting capacity, e.g., a 10-ton machine will produce as much refrigeration as the melting of 10 tons of ice every twenty-four hours. The melting of one ton of ice is equivalent to 288,000 B.t.u. One pound of ammonia expanded at 15.67 pounds pressure will absorb 555.5 B.t.u. About 510 pounds of ammonia are required to be expended to a gas to produce one ton of refrigeration.

(d) Solutions of Liquefiable Vapors. *Aqua Ammonia.* When ammonia is confined over water, it is absorbed very rapidly. At ordinary temperatures one volume of water will hold 700 volumes of ammonia. A solution of 30 per cent ammonia and 70 per cent water by weight, is called 30 per cent concentration. The pressure determines the temperature at which a solution of a given concentration, boils.

Absorption System of Refrigeration. This system is similar to the compression system having a condenser, throttle valve, evaporator and connections. In the compression system the ammonia gas is placed under high pressure mechanically, while in the absorption system, heat produces the pressure. The heat compression machine

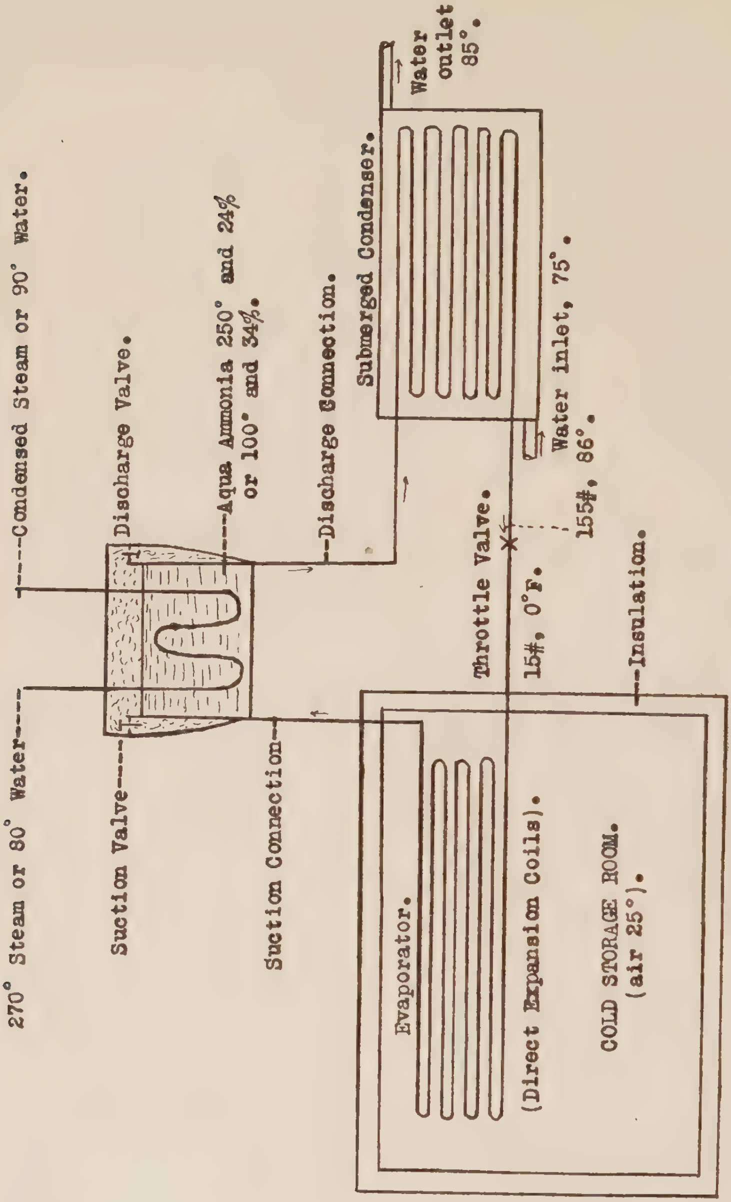


FIG. 39. ELEMENTARY ABSORPTION SYSTEM
(With Submerged Condenser and Direct Expansion Coils in Cold Storage Room)

consists of a compartment filled with aqua ammonia (for example 24 per cent concentration at 100°F.) and a pipe coil. Under certain conditions of pressure and temperature aqua ammonia can contain 34 per cent by weight of ammonia.

From the evaporator the ammonia flows into the aqua ammonia compartment where it is absorbed by the same. During this absorption the latent heat of absorption of the ammonia is liberated, and is removed by water passing through the pipe coil. This water is heated from 80° to 90° in passing through the coil. Thus the aqua ammonia concentration becomes 34 per cent in removing the ammonia gas from the evaporator.

After the aqua ammonia has absorbed all the ammonia it can hold, the water is shut off and steam at 270°F. is introduced into the coil. The steam condenses in the coils giving up its latent heat of condensation which heats the aqua ammonia from 100° to 250°F. At this temperature the aqua ammonia boils and ammonia gas and some steam is dissociated or distilled from the solution. When the aqua ammonia is reduced to 24 per cent concentration, the steam is turned off and water again is passed through the coil.

The ammonia gas is forced into the condenser, where it is liquefied, hence through the throttling valve into the evaporator, when the cycle of operations may be repeated successively.

c. Distribution of Refrigeration. (1) General. Mechanical refrigeration may be transmitted from the point of production to the point of usage by the direct expansion, indirect brine and the forced air circulation methods, depending on the kind of plant, service requirements, nature of materials to be stored and other local conditions.

(2) Direct Expansion Methods. (a) General. The refrigerant as ammonia, while confined, is evaporated in a suitable metallic container as a series of pipe coils or conduits in the room to be refrigerated, pipe coils or conduits in brine to be cooled, double or triple pipe conduits, etc. While evaporating, the refrigerant absorbs its latent heat of evaporation from the materials to be cooled and refrigeration is produced. The temperature of the ammonia is kept a few degrees below the media to be cooled, whose heat flows by natural tendency into the boiling ammonia. The resultant vapor is drawn into the compressor or absorber, while liquid ammonia is constantly admitted into the evaporator. This is called the direct expansion or evaporation method and is used for sharp and holding freezers, rooms of even temperature, where leakage of ammonia would occasion small loss and in small cold storage rooms.

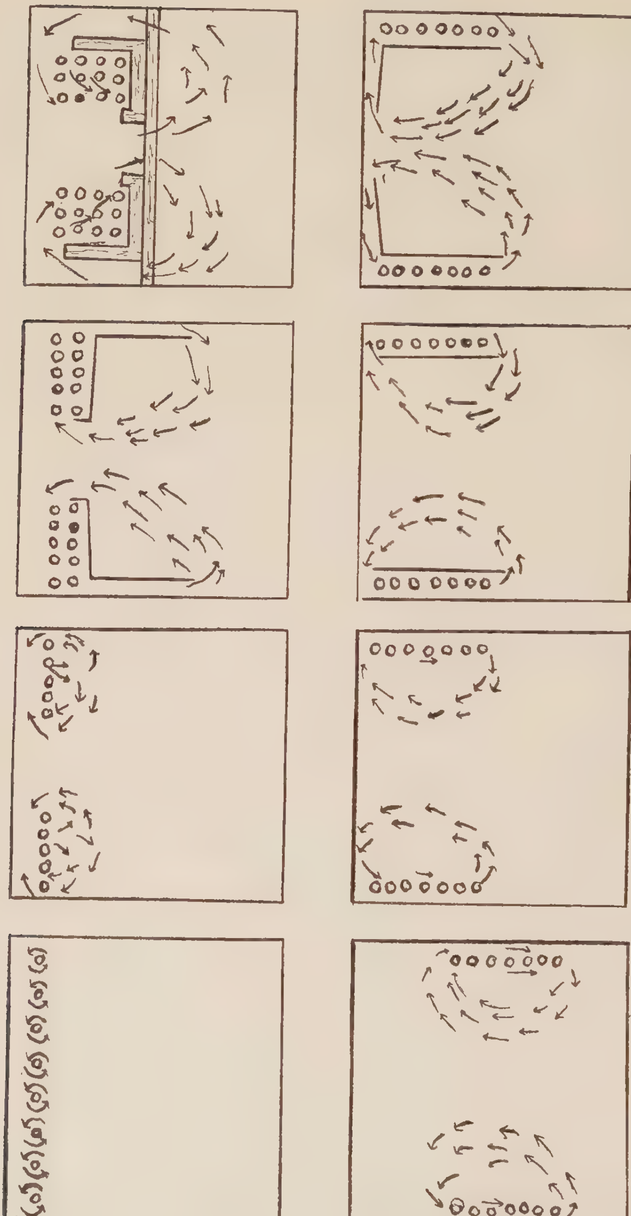


FIG. 40. DIRECT EXPANSION SYSTEM OF REFRIGERATION
(Disposition of Pipe Coils, Aprons and Bunkers with relation to Air Circulation)
(Adapted from Motz)

(b) In Rooms. The cooling of the air in a cold storage room may be accomplished by means of direct expansion coils arranged to aid the rapid gravity circulation of air across the coil surfaces. The circulating air equalizes the temperature of the room by carrying a few degrees of heat each circuit from the stored goods and distributing it on the cold surfaces of the pipes. The air is also purified by the condensation on the pipes of moisture containing objectionable foreign matter and odors. Screens or aprons in front of coils, tend to prevent moisture from being deposited by radiation on the wall or stored goods, and promote air circulation. Flat ceiling coils produce little air circulation, flat coils on the side walls produce a fair amount, ceiling coils with baffles produce a good circulation, while the best method is to have the direct expansion coils in a loft or bunker provided with baffle walls, when a vigorous air gravity circulation is produced. The air passing over the refrigerating coils is cooled, becomes heavier per unit volume, gravitates toward the floor, displaces the lighter, warmer air which then flows to the cool surfaces of the coils. In this circuit, the air absorbs a few degrees of heat from the stored goods. In chill rooms, if aprons or baffles are not provided for wall or ceiling coils, stored goods near the coils may become frozen.

(c) Hold Over Tanks. In small refrigerating plants or rooms where the refrigerating machine operates only part of the day, direct expansion coils may be supplemented with steel "hold over" tanks. Direct expansion coils are placed in this tank which is filled with concentrated brine. During the operating period, the evaporation of the refrigerant cools the brine and room, and maintains a fairly uniform temperature during the non-operating period.

(d) Congealing Tanks. These are used for the same purpose as hold over tanks. A weak brine solution is used. During the plant operating period this solution congeals or freezes. During the non-operating period, refrigeration is produced by the melting of the frozen brine.

(3) Indirect Brine Methods. (a) General. A concentrated calcium chloride brine is generally used in this method. Calcium chloride brine does not affect metals as readily as sodium chloride brine, and has a lower freezing temperature. Sodium chloride brine is used principally in the open spray and curtain methods which are discussed later. The temperature range in passing through the storage room coils (usually 3° to 6°F.) and the specific heat, determine the quantity of brine to be circulated to absorb a certain amount of heat.

Cold brine is produced through the evaporation of a refrigerant (as ammonia) in a brine cooler which may be isolated in the engine room. The brine is forced through pipes to the storage room to be cooled or in its bunker loft, and there circulated through a series of pipe coils or other apparatus, where it rises a few degrees in temperature. The warmed brine is then returned to be cooled.

(b) Brine Coolers. There are 3 principal forms used for cooling brine, the coil-tank type, shell and tube multi-pass and the double and triple pipe brine cooler.

Coil-Tank Brine Cooler. In this type, direct expansion pipe coils are situated in an open tank filled with brine and which is in connection with the cooling coils in the storage places. The warmer brine, returning from the refrigerator rooms flows over the expansion coils in this tank and is cooled a few degrees before being returned to the storage rooms.

Shell and Tube Brine Cooler. This consists of a metal shell having a suitable head to retain brine tubes. The brine circulation is enclosed in the tubes in such a manner that the brine passes through the entire length of the cooler several times while the refrigerant (as ammonia) is evaporated in the shell.

Double and Triple Pipe Brine Cooler. In this type of cooler the brine flows through the internal pipes while the refrigerant is evaporated in annular spaces between the pipes.

(c) Brine Circulating Systems. Cold brine is circulated to storage rooms by one of two methods.

In the first, the cold brine passes through the cooling coils in the storage room and the warmer brine is returned to a brine collecting tank in the engine room. On the return pipe line, the brine passes through a reducing valve just before it flows into the collecting tank. This valve is used to keep the line full of brine under pressure. A pump is then used to force the brine from the collecting tank, through the brine cooler and into the brine pipe line.

The second method is the balanced, closed system of brine circulation. A balance tank is located above the top-most brine coils, as on top of the building while the coolers and brine pump may be located on the first floor or in the basement. The pump suction is derived from the balance tank. The pump forces the warm brine through the coolers into the pipe line, through the coils in the various storage rooms then into the balance tank. A small amount of power is required to produce the velocity of the brine, to overcome friction in the pipes and other small losses.

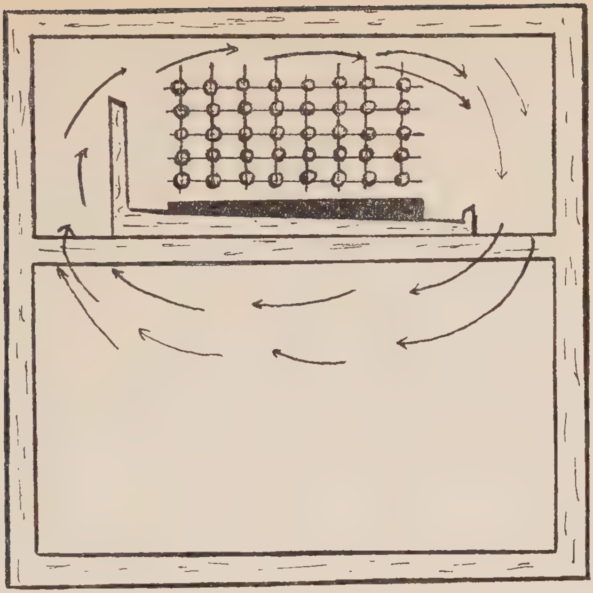


Fig. 41. Single Bunker
(Brine or Direct Expansion Coils)
(Adapted from Packers' Encyclopedia)

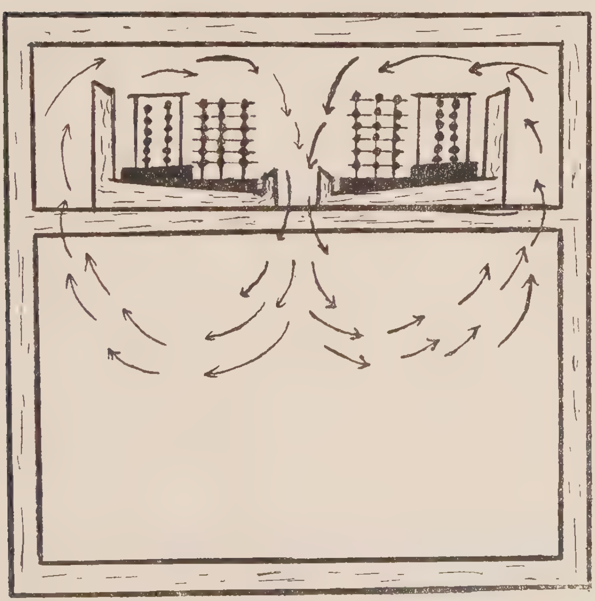


Fig. 42. Double Bunker for Rapid Air Circulation
(Direct Expansion Coils with Hold Over Brine Tanks)
(Adapted from Packers' Encyclopedia)

(d) In Rooms. Brine systems do not promote excessive drying action on storage goods. They maintain more uniform temperatures than the direct expansion system and are used in large storage rooms of uneven temperature and where leakage of the refrigerant (as ammonia) would cause great loss. There is the closed and the open system employed in rooms.

Closed System. In the closed system, the brine does not come into contact with the air. Closed coil pipes are used generally in coolers and freezers, arranged on the sides of the storage rooms, on the ceiling or in bunker lofts much the same as direct expansion pipes. The air circulation with reference to the arrangement of these coils, apply as for the direct expansion lines. Frost and ice often accumulate on the pipe surfaces especially in beef and hog coolers and should be removed. This may be accomplished mechanically or by keeping the surfaces of the pipes wetted with calcium chloride brine. The moisture which is absorbed by this brine, weakens the brine and should be removed. A concentrator is used for this purpose and the excessive moisture is evaporated out of the brine by heat. Some houses remove all the stored products from the storage rooms once a year, open all the doors and run hot water through the pipes. This defrosts the pipes and at the same time dries out the storage rooms, so that the walls and ceilings can be painted. Brine coils are used in coolers, cold storage rooms and freezers.

Open System. In the open system, which is used principally in fresh meat chilling rooms, brine comes into contact with the air, being allowed to trickle over canvas curtains or being sprayed directly into the air to be cooled, through nozzles suitably located in bunker lofts. These bunker lofts have baffle walls to aid air circulation and are provided with brine proof floors. Where the open system is used, moisture from the air and meat will be absorbed by the brine. This will weaken the brine unless suitably concentrated when necessary. The open system does not promote excessive drying action on storage goods. Sodium chloride brine is used generally in the open system because splashing with this brine does not injure meat as will calcium chloride brine.

In the brine spray system, the cold brine, under 8 to 15 pounds pressure, is sprayed through small nozzles which are located 2 to 5 feet apart in the bunker loft, depending on the amount of brine to be sprayed and the size of the nozzles. The size of the nozzle orifice averages $\frac{1}{8}$ to $\frac{1}{4}$ of an inch.

The brine on being forcibly sprayed, is broken into finely divided droplets. A rapid circulation of air is set up both by the action of the sprayed brine and the difference in gravities of the warm and cold air. This expedites rapid cooling of the meat. Care should be taken that nozzles do not become clogged with debris.

(4) Forced Air Circulation Methods. When a great amount of ventilation is required as in large chill rooms, or where it is desired to have an accurate control over the relative humidity, purity of the air, and an even temperature in all parts of a storage room, refrigeration may be produced by the forced air circulation method.

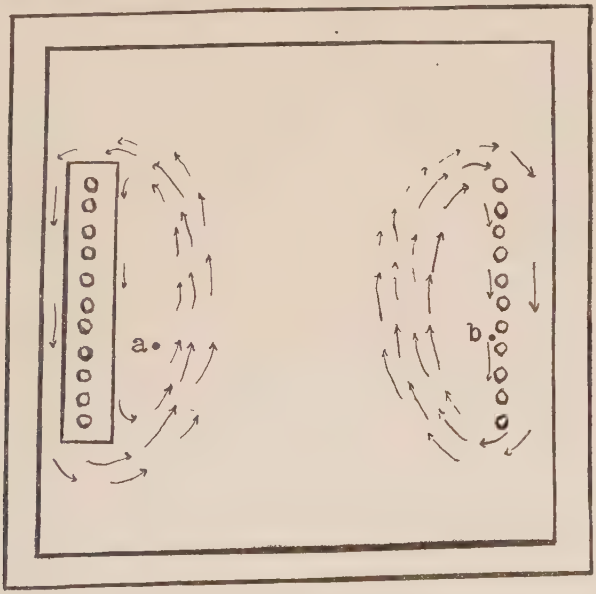


Fig. 43. Congealing Tank

a, Congealing tank; *b*, Direct expansion coils

(Adapted from Motz)

Air from the outside or the warmer air from the storage rooms is drawn through ducts into a fan, when it is blown across either direct expansion or brine refrigerating coils to cool it, thence through ducts into the cold storage rooms. Air from the outside is drawn through a shower of water which washes it free from such impurities as dust, smoke, etc., but makes it saturated. The humidity is controlled by cooling the air several degrees below the storage room temperature, exposing it to some absorbent as calcium chloride, in chunks or by heating it. Ice will also form on the refrigerating coils and must be

removed. The amount of air required to be circulated is contingent to the quantity of heat to be removed from the cold storage rooms and the permissible rise of temperature. Usually the temperature range will vary from 2 to 4°F.

A proper arrangement of the duct system is necessary to produce a uniform temperature. Ducts should be so located that a vigorous, uniform, air circulation results in all portions of the cold storage rooms. The various methods of distributing air circulation consist of warm and cold air ducts in the walls, ceilings and floors. An improved duct system where there is a cold air duct with a perforated floor and a warm air duct with a perforated ceiling gives uniform circulation of air throughout the room.

d. Construction of Storage Places. (1) General. The efficiency of a cold storage plant does not depend alone on the cold producing or cold distributing systems. Other factors of economic importance are the insulation of the cold storage rooms, their ventilation, air circulation, humidity and sanitation. Army Veterinarians should familiarize themselves with the sanitary location, construction, equipment and methods of operation of all storage places of edible products of animal origin coming under their official inspection duties (see Chapter III), also the W.D. standard specifications for refrigerators and refrigerating machinery.

(2) Insulation. The choice of a desirable, efficient insulating material for the walls, ceilings and floors of a cold storage place depends on its thermal conductivity. relative thickness, structural strength, durability, fireproofness, cost and sanitation.

It should be a good non-conductor of heat, i.e., it must transmit heat by radiation, convection and conduction at a very low rate. Insulating materials should be waterproof. Capillary absorption and extraction of atmospheric moisture by insulating materials increase the conductivity of the insulation and its eventual disintegration by repeated freezings and thawings. Insulation should be fire-retarding, slow burning or fireproof.

The insulation should be sanitary and free from tar paper, or other odoriferous substances, mould rot or moisture. It should be of such a nature as to exclude mice, rats and other vermin. The interior surfaces should be of such construction that they may be washed without affecting the insulating materials. Very few insulating materials have all of these qualities.

Insulating materials in common use are cork, mineral wool board, lith board, hair felt, dead air space, moisture-proof paper, shavings, pumice, etc. The outer and inner surfaces are usually waterproofed, cement frequently being used as a finishing material and odorless, white, lead and zinc paints for interior painting.

Cork shavings and granulated cork are pressed in metal moulds and baked, thereby bringing out the waterproof gum or rosin in the cork, binding the whole mass firmly together. Corkboards also may be made by a thorough, waterproof, odorless cementlike binding, then being pressed into molds and heated. Cork is by far the best material available for insulation. Outside brine and direct expansion pipes, brine tanks and coolers also may require insulation. Hair felt with waterproofed outer coverings may be used for this purpose. Doors and coverings for other openings should be tightly fitted and well made. The construction of insulated vestibules is sometimes desirable inside of cold storage rooms to conserve refrigeration.

(3) Ventilation. Ventilation is necessary to rid a cold storage room of permanent gases which having little affinity for atmospheric water vapor, accumulate, and are detrimental to stored products.

Many types of refrigerators and other cold storage places have little or no ventilation except such as is provided through the opening of the doors. It is not a good practice to permit outside air direct entrance into a cold storage room during summer months as it will elevate the temperature and encourage the deposition of moisture. It is also an unscientific method of ventilation. Air, before it is introduced into a cold storage room, if possible should be cooled 5° or 6°F. below the temperature maintained in such rooms. This is one of the essential features of good ventilation. Air may be properly washed, dried and cooled as discussed in "Forced Air Circulation Methods" and forced into a storage room by a fan. When malodorous substances are stored in a room, an ozone machine may also be installed. Hot chill rooms for cattle and swine carcasses should be provided with ventilators extending from above the roof to below the floor of the bunker loft. These ventilators should be open to allow the escape of steam from hot carcasses and should be closed as soon as the steam has subsided.

(4) Air Circulation. Gravity and forced air circulation systems in cold storage rooms have been discussed under "Distribution of Refrigeration." An adequate, proper and fairly strong circulation of air is absolutely necessary in cold storage rooms for the proper cooling of stored products and because it is part of the process which purifies

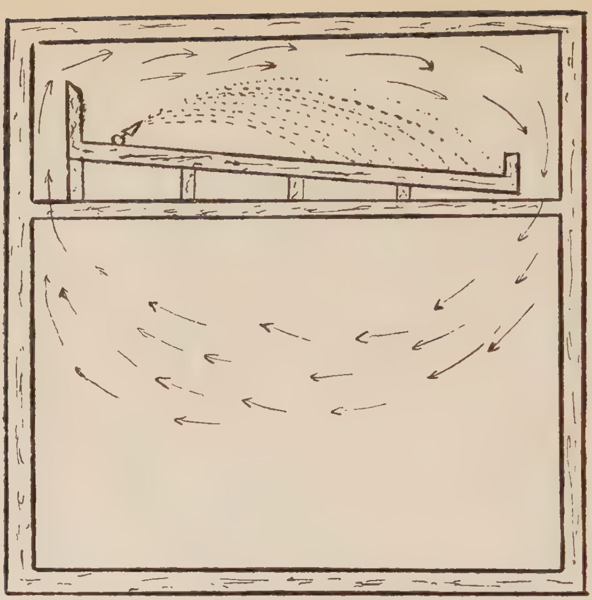


Fig 44. Brine Spray System
(*Adapted from Motz*)

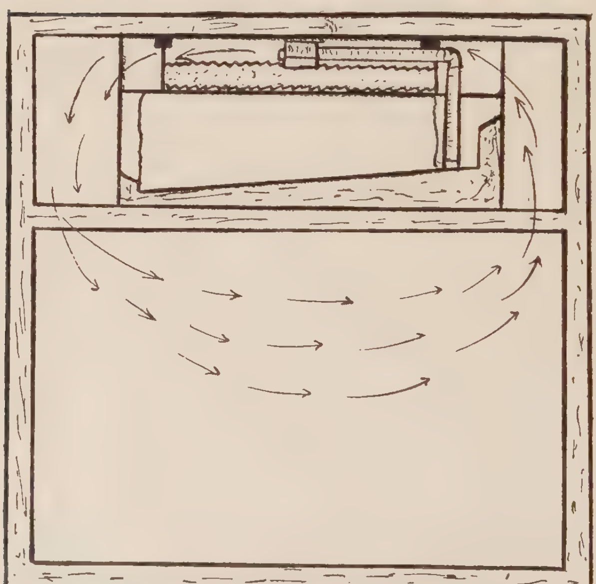


Fig. 45. Brine Curtain System
(*Adapted from Packers' Encyclopedia*)

the air. The air is purified to a large extent in proportion to the thoroughness with which it circulates and is brought into contact with the means of absorbing moisture.

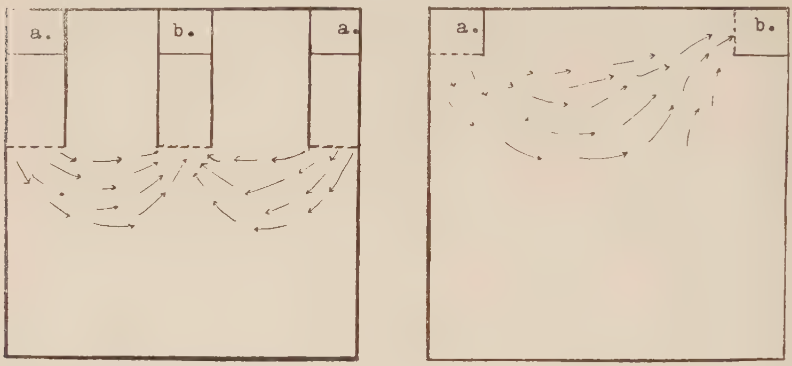
With a positive and well distributed circulation of air by mechanical means, a store room may be maintained at a humidity which would be dangerous if only a sluggish, gravity circulation of air were in operation. A brisk movement of air in all parts of the room equally removes moisture and contained impurities from the vicinity of goods, and carries them to the cooling coils there to be for the most part condensed or frozen on the pipe surfaces. Therefore, the proper circulation of air in a refrigerator is just as important as ventilation. Excessive air circulation may produce extreme dryness and excessive shrinkage.

(5) Humidity. Hygrometry is the art of measuring atmospheric moisture. The amount of moisture in the atmosphere increases with the temperature and decreases with the pressure. At 32°F. the air can hold $\frac{1}{160}$ of its weight of water vapor; at 59°F., it can hold $\frac{1}{80}$; and at 86°F., it can hold $\frac{1}{40}$. Roughly, every 27°F. increase of temperature doubles the amount of water vapor the air can hold in proportion to its weight. The atmosphere is saturated with moisture when it contains all the moisture possible at a given temperature. The degree of moisture saturation or the relative humidity is expressed as the ratio of the moisture actually present in the atmosphere to that which it would contain if saturated.

The relative humidity of cold storage rooms should differ with their temperature. Generally a room kept at 28°F. should have a relative humidity of 80°. A room at 40°F. should have a humidity of 53°. Intermediate degrees of humidity should obtain for respective intermediate temperatures. When the relative humidity reaches 80 to 85 per cent, moisture condenses and begins to show upon objects in rooms.

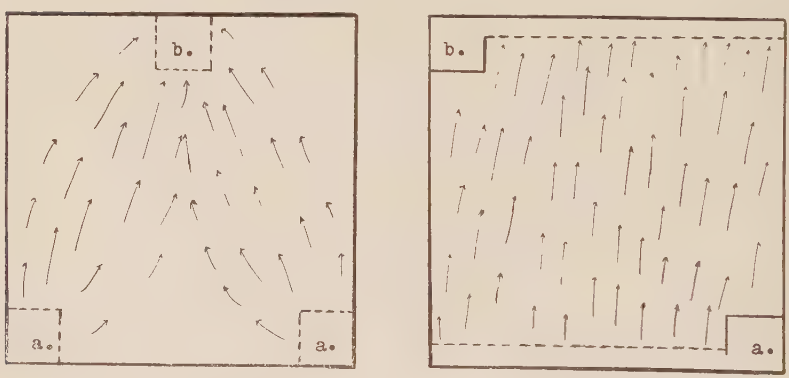
A humidity-hygrometer or a psychrometer may be used in taking humidity measurements. The latter instrument consists of two thermometers mounted on a frame. The bulb of one of these thermometers is encased in gauze or muslin. When in operation, this muslin is wet thoroughly with water and the psychrometer hung in the cold storage room for about 15 minutes. This allows the frame of the instrument to become cooled to the temperature of the cold storage room. The evaporation of the moisture from the wet gauze absorbs heat and a lower degree of temperature is registered on the

wet bulb thermometer. Both the thermometers are read, the difference in temperature is noted and the relative humidity computed from carefully prepared tables.



Primitive Type | Primitive Type

a. Cold air duct. *b.* Return air duct



Improved Type
a. Cold air duct-perforated
b. Return air duct-perforated

Improved Type
a. Cold air duct-perforated floor
b. Return air duct with perforated ceiling

Fig. 46. Forced Air Circulation
(*Adapted from Cooper-Motz*)

For the application of the psychrometer, the accompanying table may be of use. This table is for 30 inches of atmospherical pressure. Each veterinarian should secure from the local weather bureau closest to his station, a corrected table for that locality. The psychrometer does not give accurate results in rooms below 29°F. as the water on the wet bulb freezes.

Relative Humidity of Air in Per Cent of Saturated Condition at 30 Inches Atmospherical Pressure

(U. S. Weather Bulletin)

Difference between Wet and Dry Bulb Thermometer	Air Temperature													
	−20°	−10°	0°	10°	20°	30°	32°	40°	50°	60°	70°	80°	90°	100°
0.1														
0.2	82	90	93	96	97									
0.3	73	84	90	93	95									
0.4	63	78	87	91	94									
0.5	54	73	83	89	92	94	95	96	96	97	98	98		
0.6	45	68	80	87	91									
0.7	37	62	76	84	89									
0.8	28	57	73	82	88									
0.9	19	51	70	80	86									
1.0	10	46	67	78	85	89	89	92	93	94	95	96	96	96
1.5		20	50	67	77	83	84	87	90	91	93	94		
2.0			33	56	70	78	79	83	87	89	90	91	92	93
2.5			17	45	62	73	74	79	83	86	88	89		
3.0			1	34	55	67	69	75	80	83	86	87	89	89
3.5				24	48	62	64	71	77	81	83	85		
4.0				13	40	56	59	68	74	78	81	83	85	86
4.5					33	51	54	64	71	75	79	81		
5.0					26	46	49	60	67	73	77	79	81	83
5.5					19	41	44	56	64	70	74	77		
6.0					12	36	39	52	61	68	72	75	78	80
6.5					5	31	35	48	58	65	70	74		
7.0						26	30	45	55	63	68	72	74	77
7.5						21	25	41	52	60	66	70		
8.0						16	20	37	49	58	64	68	71	73
8.5						11	16	33	46	55	61	66		
9.0						6	11	29	43	53	59	64	68	70
9.5							7	26	41	50	57	62		
10.0								22	38	48	55	61	65	68
10.5								18	35	46	53	59		
11.0								15	32	43	51	57	61	65
11.5								11	29	41	49	55		
12.0								7	27	39	48	54	58	62
12.5									24	37	46	52		
13.0									21	34	44	50	55	59
13.5									18	32	42	49		

RELATIVE HUMIDITY OF AIR IN PER CENT OF SATURATFD CONDITION AT 30 INCHES ATMOSPHERICAL PRESSURE—*Continued*

(*U. S. Weather Bulletin*)

DIFFERENCE BETWEEN WET AND DRY BULB THERMOMETER	AIR TEMPERATURE													
	−20°	−10°	0°	10°	20°	30°	32°	40°	50°	60°	70°	80°	90°	100°
14.0									16	30	40	47	52	56
14.5									13	28	38	45		
15.0									10	26	36	44	49	54
15.5									8	23	34	42		
16.0										21	33	41	47	51
16.5										19	31	39		
17.0										17	29	38	44	49
17.5										15	27	36		
18.0										13	25	35	41	46
18.5										11	24	33		
19.0										9	22	32	39	44
20.0											19	30	36	41
21.0											15	26	34	39
22.0											12	23	31	37
23.0											9	20	29	35
24.0											8	18	26	33
25.0											6	15	24	30

The interrelation between ventilation, humidity and impurities in cold storage rooms is very close. Impurities in the form of gases emanate from stored products and tend to become absorbed in collected moisture. Collected moisture favors the growth of mould and products become slimy more quickly if stored in a refrigerating room not containing means for the elimination of moisture. Humidity may be controlled if proper means are provided. Absorbents, ventilation and air circulation are all useful for this purpose. Moisture may be absorbed through free circulation whereby the moist air comes into contact with the refrigerating pipes. A fan may be installed over a container of deliquescent calcium chloride (chloride of lime, *not chlorinated lime*). Troughs should be suspended under cooler coils to conduct any drip to the sewer. Sweating ceilings in hot coolers may be reduced to a minimum through forced air circulation by means of fans. (Also see "Air Circulation.") Ice on coils should be removed frequently otherwise the refrigeration efficiency will be retarded.

e. Cold Storage of Commodities. (1) General. The function of

cold storage places is to preserve products and to extend the seasons of distribution, therefore, it is important that an abundant supply of refrigeration is available, that the cold storage rooms are sanitary, properly constructed and equipped and efficiently operated.

Rooms in which fresh meats are stored above freezing temperatures are designated "chill rooms" or "coolers" while those in which meats are frozen or stored in a frozen condition are termed "freezers."

(2) Chill Rooms. (a) Offal. The preliminary chilling of offal, according to its nature may be accomplished with ice water, cracked ice or in a chill room. (See Beef, Veal, Mutton and Pork Offal.) Usually it is washed thoroughly with clean water to remove mucus, blood or other contaminations, properly trimmed from inedible portions, placed on perforated pans or trays, or hung on racks which are then sent to the chill rooms. Fresh, clean sawdust should be placed on cooler floors to absorb drippings. A rapid air circulation to carry off and dispose of heat and moisture is essential. Offal contains a high percentage of moisture and offal chill rooms are prone to become damp due to the large amount of moisture shrinkage from the products. It is not possible to keep offal in chill rooms for a long period of time, therefore this class of products after thorough chilling is packed as expeditiously as possible for shipment or for the freezer.

(b) Trimmings. Bull carcasses while still warm are sometimes boned out and the boneless pieces finely divided and chilled. A large amount of steam will arise during this cooling operation. (Also see Beef, Veal, Mutton and Pork Trimmings.)

(c) Carcasses and Cuts. Freshly dressed carcasses from the killing floor are weighed and have a card attached bearing the lot number, name of the commission firm which sold the lot, the hot weight and date killed. This card may contain data pertaining to the "house" grade. Hog carcasses may not be tagged or weighed before chilling.

Beef. In chilling carcass beef, two steps are generally recognized, i.e., the preliminary chilling of the warm carcass wherein most of the initial or animal heat is removed and their final chilling and storage. In large packing houses which are equipped with multi-coolers, both steps may be accomplished in same cooler, in other establishments the carcasses are first run into a "warm," "hot" or "fore" cooler for about eighteen to twenty hours then into the "main" cooler. In no event should warm carcasses be chilled in a cooler containing chilled carcasses as moisture will be condensed on the chilled sides and slimy conditions result. During cold weather, warm carcasses are sometimes spaced on an open hanging floor for the initial cooling.

For domestic trade, cattle carcasses are run into a "fore" cooler where it is advisable to space the sides at least 6 inches apart to insure air circulation and proper chilling. Usually one rail will have the sides of each carcass spaced bone to bone while on the alternate rails the sides will be spaced back to back. The temperature which at filling may be 30 to 34°F., rapidly rises but should not be permitted to go above 45°. After the steam vapors have been given off from the warm carcasses, the temperature of the cooler is gradually reduced to 38° at ten hours after filling and to 36° after eighteen to twenty hours. At this time carcasses are transferred to the main coolers where the temperature is reduced until it is 35° at thirty-six hours, and after forty-eight hours, 32 to 34°. Light cattle and canner cows may be shipped out, divided into cuts, or boned in thirty-six hours, medium weight carcasses in forty-eight hours while heavy cattle should remain at least seventy-two hours in the chill rooms.

After twenty-four hours in the chill rooms, the temperature in the hip joint and in the shoulder of heavy sides will be about 51 to 54°, at forty-eight hours it will be about 42° and at seventy-two hours about 38°.

For export cattle, the hot carcasses enter the cooler at 45°. It is thought commercially that a lower temperature will destroy the "bloom." These cattle are spaced 18 inches to 2 feet apart. In twenty four hours the cooler temperature is about 36° and in forty-eight hours, 31° Such cattle should be held in the cooler until 72 hours have elapsed.

Refrigeration pipes should have troughs underneath to prevent water from dripping on the meat. White or slimy spots on the surface of sides may be caused by drippings. Rails should be kept well painted, clean and free from rust. Trolleys, hooks, pipes or other equipment should be kept clean and in good condition. (See Chapter III.)

The principal factors which control the length of time chilled beef can be held in cold storage rooms above freezing, are the character of the beef, temperature of storage and the humidity of the storage rooms. Carcasses from highly finished, grain fed animals will keep for a relatively long time. The flesh of such carcasses is firm and in large part it is protected by a firm, fat covering, from bacterial invasion. Thin carcasses with large, exposed areas of muscle tissue or which do not firm out on chilling, deteriorate rapidly (see Biochemic Meat Spoilage). The temperature for fresh, chilled beef storage should not exceed 32° F., and where possible 31° is a preferable upper limit. The upper

commercial limit of safety is 40°. The humidity of commercial beef storage rooms is usually about 92 to 95 per cent of saturation. Under these conditions, with a temperature of 31°F., fresh beef has been held fifty-five days. The "hot" or fore coolers filled with warm beef may have a 100 per cent relative humidity.

Carcasses may be divided into market or boneless cuts. These may be delivered unwrapped or wrapped in cheese cloth, muslin, waxed or parchment paper and may be packed in paper lined boxes for freezing, cold storage or for export. If beef cuts are held chilled for a time before shipment, they should be stored in a temperature from 24 to 32° until loaded.

Pork. Swine carcasses may be spaced on a cooling floor and held until most of the animal heat has been removed. They are then run into a hog chill room which is divided into compartments the better to control refrigerating temperatures. Carcasses must not touch but should be amply spaced to insure air circulation and uniform, rapid chilling. When starting to fill, the cooler temperature is about 30 to 32°F. After running in the warm carcasses the room temperature rapidly rises but should not go above 45°. After being filled, the compartment doors are closed and the temperature allowed to remain at about 44 degrees for 2 hours during which time the steam vapor leaves the carcasses which begin to dry. By regulating the brine system, the temperature at the end of ten hours is reduced to about 36°, at twenty-four hours 32°, and at forty-eight hours 30° to 32°. Pork carcasses are ready for cutting room in forty-eight to seventy-two hours of chilling. The average cooler shrink for forty-eight hours is 2.6 per cent, and for seventy-two hours, 2.7 per cent of the hot dressed weight.

From the pork cutting room, pork cuts should be handled as quickly as possible, observing strict sanitary methods. For fresh meats, pork cuts as loins, shoulders and Boston butts may be wrapped in oiled or butcher's waxed paper to prevent exposure to the air and packed in wirebound boxes, crates or barrels; tenderloins in tin pails which hold 10 pounds net, and spareribs, pigs feet, neck bones, etc., in barrels, boxes or other containers. Fresh pork should be held under refrigeration at all times. If kept for two or three days pork cuts should be stored at 18 to 24°F. For longer periods, they should be frozen, as pork cuts lose their fresh appearance and color after five or six days in chill room temperatures and appear stale. Fresh pork which has been properly chilled and handled, when kept in proper storage at

destination under temperatures ranging from 34 to 36°F. should last eight to ten days. Pork cuts for curing are sent immediately to the curing cellars or are frozen to hold.

Veal and Mutton. Veal and mutton carcasses being relatively thin do not require such low temperatures to chill. They are usually chilled and stored at about 34 to 36°F. Commercially, veal carcasses are usually chilled with the hide on after which the hide may be removed or the carcasses shipped out with the hide on. A very small per cent of lambs may be chilled with the pelts on. Carcasses may be delivered naked or wrapped in stockinette or muslin. For the freezer they may be bagged with muslin or stockinette, covered with burlap.

(d) Changes in Flesh during Chill Room Storage. *Rigor Mortis.* During life, normal musculature is composed chiefly of semifluid muscle plasma which is slightly alkaline. After slaughter it becomes acid in reaction due to the production of lactic acid from muscle carbohydrates and possibly proteins. The soluble proteins are coagulated forming a muscle clot (rigor mortis). The principle protein of this clot is myosin. Rigor mortis may be retarded by an overabundant supply of oxygen or by low temperatures.

Ripening. Rigor mortis gradually passes away with a relaxation of muscle tissues coincident to an auto-digestion or "ripening" process wherein the meat becomes tender. This ripening process is produced by a proteoclastic enzyme (protase) and is not due to bacterial decomposition, which, however, may overtake auto-digestion and become the dominating factor especially when meat is in small pieces or where larger pieces are held too long or at too high a temperature.

The general run of chilled beef is disposed of within 4 days after slaughter, however, for certain select trade as high class restaurants, hotels and dining car service ripened or "aged" beef is desired. Suitable cuts, quarters or sides of beef may be ripened by packers for trade concerns, using a dry cooler with good air circulation. Here the beef cuts are held two to six weeks at about 34°F. Some hotels hold beef thirty to sixty days.

The ripening process in quarters or sides of beef, held at 34 to 38°F. reaches its maximum at fifteen to twenty-one days when the bacterial penetration ordinarily has not extended more than $\frac{1}{16}$ to $\frac{1}{8}$ of an inch below the surface. In dry coolers of a low humidity, meat usually shows a slight growth of mould (whiskers) in two to three weeks and a heavy growth after four to six weeks. Mould first appears and grows most prolifically on the cut surfaces of the lean meat. When sold, the

meat is wiped free from mould and trimmed, the purchaser paying for all trimming loss.

Shrinkage. The amount of moisture shrinkage for fresh meats depends on the kind of meat, age of the animal, kind of feeding, condition or finish, handling of the carcass, storage temperatures, humidity, air circulation, osmotic pressure, length of time in storage and other conditions which may be met with in meat coolers, freezers, mobile cold storage rooms, and other storage places. As much as $\frac{1}{2}$ per cent difference may result in the weight of a dressed beef carcass from the manner in which washing and wiping is conducted in the dressing process. The weight and thickness of a carcass in proportion to the exposed surface, also the fat covering, affect storage room shrinkage. Under ordinary packing house conditions, the cooler shrink on dressed beef is $1\frac{3}{4}$ to 4 per cent, and the branch house shrink 1 to $1\frac{1}{2}$ per cent. Dressed mutton has a 2 to 5 per cent cooler shrink and 2 to $2\frac{1}{2}$ per cent branch house shrink. Pork has a cooler shrink of $1\frac{1}{2}$ to 3 per cent and veal 3 to 7 per cent. Dressing, trimming and boning shrinks also should be considered.

Spoilage of Meat. Practically all spoilage of fresh meats is due to bacteria or moulds. When these are absent, changes will be slow although oxygen and water are present. Chemical and biochemical changes affect the composition hence the nutritive value of meats and may produce alterations in odor and in flavor.

Chemical Changes. Rancidity of fats is due to oxidation and does not require the presence of microörganisms. The products of rancidity may include aldehydes, ketones, free fatty acids, hydroxy acids lactones, alcohols, acetals, terpenes and esters of various fatty acids with higher alcohols.

Hydrolysis of fat produces fatty acids and glycerol. Hydrolysis of lean meat occurs slowly at chill room temperatures in the absence of microörganisms and rapidly at high temperatures being accelerated by enzymes. In this process, gelatin and albumoses (proteoses) are produced.

Biochemic Meat Spoilage. At slaughter, normal muscle tissue from healthy animals is generally free from bacteria. However, a more or less rapid penetration, extension and development even in remote regions as the hip joint may result when evisceration is not prompt, if insanitary implements or practices are used in dressing the carcass, when hog carcasses are left too long in the scalding vat or fallen carcasses are allowed to remain too long on the floor. Dirty wash water,

contaminations, unclean meat hooks and improper chilling of carcasses also may be productive of bacterial growth.

Under the best of conditions, normal fresh meats undergo progressive decomposition beginning with the slaughter of the animal. There are two methods by which bacteria will enter or penetrate chilled cuts or sides of beef held under good chill room conditions, i.e., by direct extension of surface colonies into firm tissue and by extension and locomotion along moist surfaces and tubes as lymph vessels, nerve sheaths and blood vessels.

Extension of Surface Bacteria. The surface of meat is more or less contaminated with bacteria which grow, form colonies, spread over the surface and then penetrate the meat. Motility does not play any great part in this penetration which is slow and regular. The harder and drier the surface, less rapidly will its penetration obtain, but once it is pierced, bacterial progress is rapid. When connective tissues covering muscle are dry, resembling parchment, bacterial penetration is difficult. Thus there is an advantage in having carcasses as dry as practicable upon going into coolers and also for a certain amount of desiccation in chill rooms.

In twenty days' chill room storage, a cut section of the meat will show a narrow, sharply defined, dark border, extending all around the cut. The width of this border represents the extent of bacterial penetration and increases with the time in storage. In thirty days it may be about 1 c.m. wide.

If the air is dry, no slime will form on the meat. If the air is moist or air circulation poor, a thick layer of slime consisting of quantities of bacteria will result and later an abundant growth of mould will appear.

Extension of Bacteria along Moist Surfaces and Tubes. By this method, at a relatively early period bacteria reach the interior of the meat, set up foci of decomposition, spread and finally merge with each other and with the surface colonies until the meat contains bacteria throughout and is in an active putrefactive stage.

The bacterial decomposition of meat, except on the surface, is a typical putrefaction with a tendency toward the formation of simpler compounds by hydrolysis such as water, carbon dioxide, sulfates and phosphates. At the same time from simpler compounds, bacteria synthetically produce complex substances, as ammonia, hydrogen sulfide and other products of pronounced odor.

Tabulation of Chemical and Biochemical Deterioration of Fresh Meats

(*Modified—After Richardson*)

Chemical—Water, Oxygen of Air

Fat.......... *Hydrolysis*, active agent water, products fatty acids and glycerol.

Oxidation (rancidity), active agents water and oxygen, products free fatty acids, hydroxy acids, lactones, alcohols, esters of various fatty acids with higher alcohols, aldehydes, ketones, acetals and terpenes.

Lean......... *Hydrolysis* occurs slowly at ordinary temperatures in absence of microörganisms; enzymes act as accelerating agents; occurs rapidly at high temperatures with production of gelatin and albumoses (proteoses).

Oxidation occurs slowly in presence of oxygen of air at ordinary and moderately high temperatures, even in absence of microörganisms.

Biochemical—Microörganisms

Lean......... *Decomposition* by microörganisms. Hydrolysis is chief chemical action. In presence of oxygen, oxidation plays a part, the sulphur compounds being affected and much carbon dioxide being evolved:

Putrefuction (anaerobic) produces reduction products of foul odor, ammonia, hydrogen sulfide, amines, skatole (acids).

Decay (aerobic) produces products with scarcely any pronounced disagreeable odor (no hydrogen sulfide).

Mouldering (aerobic by moulds) produces the typical odor of "mouldiness," possibly due to acid amides.

One experiment indicates that fresh chilled beef twenty-four hours after slaughter may contain 0.03 to 0.10 mgm. of ammonia nitrogen per gram of meat. When kept at room temperatures (59 to 77°F.) bacterial growth was rapid and meat became unsuitable for human food when the ammonia nitrogen reached 0.30 to 0.40 mgm. per gram of meat, in some instances after twenty-four hours. When stored at a low temperature (32 to 40°F.) there was very little bacterial growth but a considerable growth of mould. In three to four weeks the meat was still fit for human food after trimming off the mould. Autolysis, however, proceeded with a great increase of cleavage products. such as compounds rich in amino nitrogen, and ammonia, without the formation of products whose flavor, odor and appearance make meat unfit for food. At these low temperatures the ammonia content varied from 1.00 to 3.00 mgm. per gram of meat before it was unsuitable for

use. When meat which has been kept in cold storage is brought into room temperatures or above, decomposition quickly ensues due to the simpler products of autolysis acting as a very desirable nutritive medium for bacterial growth.

Ham Souring. In freshly chilled swine carcasses, bacteria identical with those present in sour hams, are frequently present in the marrow of the femur, the synovial fluid of the stifle joint and in the meat. This may be caused through animals being overheated or fatigued at slaughter, too high a temperature in the scalding vat, carcasses too long in the scalding vat, fallen carcasses lying too long on floors. delayed evisceration, contaminations from floors, dirty implements or equipment; delayed or inefficient chilling and lack of low uniform chill temperatures. To check the development of these germs which may be present in swine carcasses, the chilling should be prompt, rapid and efficient. The carcasses should be properly spaced in the chill room. Pork cuts should be promptly handled in the cutting rooms and held at a low, uniform temperature into cure

Other Conditions. Decomposition in quarters of heavy beef carcasses is considered under Carcass Beef. Meat may become contaminated with pathogenic or saprophytic organisms (some of which are capable of producing meat poisoning) from human, vermin or other sources through exposure to dust, dirt, flies, rats, handling and highly contaminated meat blocks, benches, implements or floors. Meat may also become affected with insect larvae or absorb off odors.

(3) Freezers. (a) General. The preservation of fresh meats by freezing is a very valuable economic factor of recent development. Surplus meat can be frozen and held until periods when the supply is scarce. Frozen meats can be transported great distances. Fresh meats which are frozen include quarters of beef, carcasses of veal, mutton and pork, standard wholesale market cuts, certain boneless cuts, trimmings and offal. Some of these products are frozen in boxes or tin containers, other have various kinds of wrappings, while some are frozen unwrapped.

(b) Preparation of Meats for Freezing. All meats to be frozen should be from officially inspected and passed carcasses from recently slaughtered animals. They should be sound. Freezing will not improve the condition of an unsound product which frequently will deteriorate quite rapidly upon being defrosted. All meat should be thoroughly chilled and properly prepared before being placed into a freezer.

Carcasses and Quarters. Beef sides are "ribbed" into quarters. For domestic trade they are frozen nude while for export, quarters are covered with stockinette next to the meat with burlap over all. For the Army, beef quarters may be enclosed in wrappings (see "Wrapping-Carcass Beef") or handled unwrapped after freezing as required. Quarters are hung in the sharp freezer from rails by means of hooks or trolleys with at least one foot of space between each quarter.

Veal, mutton and pork carcasses may be suspended from overhead rails and properly spaced. Carcasses of mutton or veal may be bagged with a double covering of muslin or stockinette and burlap.

Boxed Meats. Fresh meats to be frozen in boxes or molds or other containers are piled in tiers in such a manner as to allow a free circulation of air around all surfaces of the containers. Boxes may be "staggered" by resting the edge of one box on the edges of the boxes below it. Floor racks should be used under tiers.

The boxes or molds used for freezing boneless beef to be exported may be made of wood, 29 inches long, 20 inches wide and 6 inches deep, inside measurements. These boxes may be lined with oiled paper, muslin or stockinette, as desired, and after the contents are frozen the frozen meat is removed, enclosed in required wrappings and burlap sewed over all.

Offal. Offal may be frozen in shallow pans, boxes or other containers.

(c) Freezing. Fresh Meats. For freezing, temperatures from 10°F. to 10 degrees below zero F., are employed, refrigeration being produced by calcium chloride brine or direct expansion coils placed overhead near the ceilings.

The rate at which a fresh meat product freezes depends on many factors, as, kind of meat, their weight, thickness, specific heat, methods and kinds of wrappings, or packing, spacing, room temperature, etc. (See "Refrigerating Load.") Offal with its greater moisture content will freeze more rapidly than lean meat. Lean meat will freeze before fat, and beef and mutton fat more rapidly than swine fat. Heavy, thick quarters of beef require a longer time to freeze than do thin, mutton or veal carcasses. Quarters of beef suspended and properly spaced will freeze more quickly than when stood on end on the floor. Meats packed in tin which is a good conductor of heat, will freeze rapidly. Cloth wrappings somewhat retard freezing. Paper wrappings and wood containers being non-conductors of heat greatly retard freezing of meats contained therein.

Freezing fresh, chilled, quarter beef depends on the temperature of the meat going into the freezer, the temperature of the sharp freezer, and also to some extent on whether the beef is covered for export or nude for domestic trade.

Chilled beef quarters received from refrigerator cars, suspended on rails and properly spaced in a freezer maintained at 10° below F. may freeze solid in seventy-two to eighty-four hours (see Carcass Beef). When partially frozen and piled, three weeks may be required at this temperature. When piled on edge on floors or on racks at 5° above zero F., beef quarters may require more than three weeks to freeze. Meat in boxes or molds properly staggered and held at 10° below zero F., may freeze solid in three days to one week. Pork cuts, wrapped in paper and packed in tight boxes, freeze with difficulty. Offal in shallow pans freezes quickly.

(d) Storage of Frozen Meats. After freezing, meat may be tiered on floor racks in a holding freezer and stored at zero to 10°F. until ready for shipment. This low temperature storage will guard against break downs of refrigerating machinery and is more desirable than higher temperatures as a measure of safety. If meat were stored in the sharp freezer, an excessive shrink might result. Commercially, a thin layer of water may be sprayed on floors beneath carcasses suspended in the holding freezer. It is thought that the evaporation from the ice which forms increases the humidity within the room and thus reduces the shrink.

Thoroughly frozen meats may be piled in the holding freezer using clean substantial floor racks in good repair. Offal, frozen in shallow pans may be boxed or other wise packed. In a holding freezer, meats may be held safely for one year.

Fresh frozen beef may shrink $1\frac{1}{2}$ per cent the first month, and 3 per cent for six months' storage. Mutton does not shrink as much as beef or veal and for the first three months in storage the shrink may average $1\frac{1}{2}$ per cent.

(e) Effect of Freezing on Meats. Lean meat or musculature may be considered as being composed of elongated sacs filled with fluid containing proteins, salts and extractives in aqueous solution. This fluid has a freezing point of 31.3°F. The soluble proteins (colloids) play a very small part in the freezing process. Ice forms *outside* of the muscle fibers and not inside. The aqueous portion separates from the cells and freezes on the outside. As the temperature is lowered, more ice is formed with a more concentrated solution remaining inside

the cells. If the temperature is reduced sufficiently and maintained long enough, the whole mass will become solid. The muscle fibers are forced to assume progressively a smaller bulk until they are reduced to thin strands separated by relatively large masses of ice. The concentrated solution within the fibres becomes so viscous that it is practically solid.

Cold Storage and Freezing Temperatures

(After Cooper)

Factors which determine the best suitable temperature for storage of food products of animal origin are condition of product, length of time to be stored, conditions of air circulation, ventilation, humidity, etc.

The following arbitrary average cold storage temperatures used in practice may act as a guide only and should be changed to meet varying conditions:

PRODUCT	°F.	PRODUCT	°F.
Butter	14	Meat, fresh, (10 to 30 days)	30
Butterine	20	Meat, fresh (few days only)	35
Canned Meats	40	Meats, salt (after curing)	43
Caviar	36	Mild cured, pickled salmon	33
Cheese (long carry)	35	Milk (short carry)	35
Cream (short carry)	33	Oils	45
Dried beef	40	Oleomargarine	20
Dried fish	40	Oxtails	30
Eggs	30	Oysters, Iced (in tubs)	35
Fish, fresh water (after frozen)	18	Oysters, (in shell)	43
Fish, not frozen (short carry)	28	Poultry (after frozen)	10
Fish, salt water (after frozen)	15	Poultry, dressed (iced)	30
Fish (to freeze)	5	Poultry (short carry)	28
Frogs legs (after frozen)	18	Poultry (to freeze)	0
Game (after frozen)	10	Ribs (not brined)	20
Game (short carry)	28	Salt meat curing room	33
Game (to freeze)	0	Sardines (canned)	40
Hams (not brined)	20	Sausage casings	20
Hogs	30	Scallops (after frozen)	16
Ice cream (few days only)	15	Shoulders (not brined)	20
Ice storage room (refrigerated)	28	Strained honey	45
Lard	40	Tenderloin, etc	33
Livers	20	Veal	30

When stored in a solid, frozen condition, the oxidation of fat is slow and proteolytic enzyme action slight. The growth, reproduction and activity of certain bacteria in a suitable liquid medium progresses to as low a temperature as the cryohydric point of plain brine (−22°C.). It is the solid condition of frozen meat and not the temperature limits

so much, which inhibits bacterial growth. The temperature at which any medium is sufficiently frozen to preclude all bacterial growth and reproduction, is termed the "cryabiotic" point. Decomposition of fat and lean meat when it occurs, takes place either before freezing or after defrosting or thawing.

(4) Storage of Fresh Meats at Military Stations. Fresh meats intended for troops may be stored at destination as at camps, posts or other military stations, in refrigerators, coolers, cold storage rooms, refrigerator cars, markets, or other places or compartments operated under widely, varying conditions. The frequent sanitary examination of all such storage places devolves upon the veterinarian while mess refrigerators and restaurant storage is included in the general sanitary inspection service (see Chapters II, III and VIII, section 8).

(5) Defrosting Meats. (a) General. This is an important operation and should receive close attention. Meats should never be defrosted in water with the exception as of beef trimmings intended for canned products, because bacterial decomposition is more rapid in meats so defrosted. High temperatures are also conducive to bacterial decomposition, excessive shrinkage and a loss in color.

(b) Beef. *Slow Process.* The slow process of defrosting frozen beef is more advantageous than the "forced" method. For example, frozen beef may be removed from a freezer and placed into a cooler having good air circulation and maintaind at 38°F. Here the beef is held four days when it should be in a defrosted condition with a moisture shrinkage of 1 to 1½ per cent.

Forced Process. In the forced method which ordinarily is used only in an emergency when meat is needed or for prepared products, the frozen beef is placed into a room (sweat box) at 68° to 72°F. or more. Here it remains about forty-eight hours with an attending shrink of 3½ to 4 per cent or even more.

In Cars. In warm weather when it is necessary to defrost beef at destination stored in a refrigerator car the beef may be spread out in the car and fans installed to create a forced circulation and any desired defrosting temperature maintained, being controlled by means of the doors and ice bunkers. Soaking tubs are not desirable.

(c) Pork. Fresh, frozen pork may be defrosted by the slow method using temperatures from 34 to 38°. This produces the best results. When spread out in a steam heated room at about 80°F., constant attention and strict sanitation are required. Products to be placed immediately into cure, may be defrosted in warm pickle.

f. Manufacture of Ice. (1) General. There are two general methods of artificial ice making, i.e., the plate and the can systems.

(2) Plate System. The plate system of ice making was devised to manufacture clear ice from raw water. Steel plates, 9 by 12 and up to 10 by 18 feet in size are bolted to refrigerating ammonia or brine coils. These plates are immersed in a vertical position in large tanks filled with the filtered water to be frozen. Ice anchors are also placed in the water to enable the resultant ice to be hoisted. Heat is absorbed from the water and ice begins to form on the surface of the plate (on one side only), freezing from the plate outward. In freezing, impurities as gases and sediment are extruded from the ice. This operation is assisted by constant air agitation to insure a clear ice. It requires six to eight days to freeze ice 12 to 14 inches in thickness. An 8 by 14 foot plate will make 5 tons of ice at one time. When the ice has attained the desired thickness the expansion or brine valve is shut off and the ice allowed to temper for ten to twelve hours to prevent cracking of the ice when the hot ammonia gas or brine is introduced into the coils to thaw it loose. After being thawed loose, the block of ice is hoisted by a crane, placed on a saw table where it is divided into suitable cakes and placed into the ice storage room.

(3) Can System. (a) General Manufacture. In the can system, the water which is to be frozen is placed by means of a hose or an automatic filler into suitable, rectangular, sheet iron cans capable of holding 300 to 400 pounds of finished ice. These cans are nearly submerged in cold calcium chloride brine contained in a large, insulated, steel tank. The cold brine is constantly refrigerated to from 10 to 18°F. by direct expansion coils. The brine absorbs heat from the water in the cans and carries it to the direct expansion coils with its active refrigerant. The brine is kept in constant agitation by a propeller agitator. This equalizes the temperature of the brine in all parts of the tank and increases the heat transmission through a higher velocity.

The water in the tanks is reduced to 32°F. when ice begins to form on the surfaces of the cans. The rate of freezing is rapid at first but becomes progressively slower. When the water is entirely frozen solid, (in about fifty hours) the cans are hoisted from the brine tank, sprayed with or immersed in warm water sufficiently to loosen the ice from the cans which are then dumped. The ice is placed into an ice storage room at about 28°F. to be held till needed or until sent to the consumer.

(b) Air Agitation. The exact nature of the water determines whether the resultant ice will be opaque or clear. Pure distilled water will produce clear ice if properly frozen. In freezing raw water containing air, mineral matter or suspended solids, crystals of pure water form extruding these impurities. Small quantities of these impurities are caught between the ice crystals and appear white, opaque or colored and give to the resultant block of ice an opaque appearance referred to as "tombstone" ice. Clear ice may be produced from raw water in the can system when suitably agitated by compressed air.

Low Pressure Agitation. Compressed air under 2 to 5 pounds pressure is brought to the cans by lateral pipes. Small "T" (drop) pipes are connected with these lateral pipes, being placed in the can so as to extend to within 6 to 12 inches of the bottom. The air is introduced into the bottom of the can and causes agitation similar to boiling. As water freezes, the movement of water across the frozen surface of the ice prevents air and other impurities from being incorporated with the ice crystals. This process is continued until the ice is nearly solid and the impurities have been concentrated in the core of water in the center around the drop pipe. Should this core of impure water be frozen, an opaque center would result. To prevent this, the core may be pumped out, when the space is refilled with fresh water and the air agitation and freezing are continued. When the ice is very near the end of the drop pipe, the latter is removed and freezing continued until the core has been frozen.

High Pressure Agitation. In this system, the air pipes are soldered permanently on the can, inside at the corners, on the sides or outside and entering at the bottom. Cooled, dried, compressed air under 15 to 30 pounds pressure is introduced into the cans during the freezing operation. When only a small amount of mineral matter is present in the water to be frozen, it may be allowed to freeze without removing the core, otherwise the core may be removed as described above.

(4) Water. (a) Sanitary Requirements. All water used for washing meat containers, implements, hands, carcasses or products; for soaking, cooking, or other preparatory process, or for the manufacture of ice, should meet the sanitary requirements of the Surgeon General as shown by sanitary water analysis. Any existing impurities should be within recognized allowable limits. Ice used in contact with products should be from water of unquestioned purity and it should be produced, handled and stored in a sanitary manner.

When water crystallizes, suspended and dissolved materials are extruded with non-aqueous matter as air in which microörganisms

remain without being injured or crushed. In solid, clear, crystalline ice, bacteria are mechanically destroyed, while bubbly, snowy or opaque ice may have bacteria in abundance. Through contaminations, ice may contain more bacteria than the water from which it is manufactured. Low temperatures may also favor bacterial longevity. Ice should be free from dark or other granular deposits.

Ice should not be dragged over dirty, sputum ladened, bloody or other contaminated floors and should not be contaminated from soiled clothing or filthy hands.

(b) Commercial Purification. Many kinds of water contain dissolved mineral, organic or other suspended matter which when frozen into ice cause discolorations, sediment or other deposits. Such waters are unsuitable for ice without purification which may be accomplished by distillation, by softening with lime and soda ash, or by the zeolite process.

A common impurity in water is the bicarbonates of magnesium and calcium (dissolved limestone) which constitute temporary hardness. When such water is boiled or frozen, carbon dioxide is evolved and carbonates formed. In ice, the carbon dioxide creates opaqueness, while the carbonates form sediment. A large amount of mineral matter tends to cause ice to be fragile. Sulfates, nitrates and chlorides which made water hard, during ice manufacture become concentrated in the core and may retard the freezing process. Iron oxide may cause a yellow or brown discoloration. Organic material may cause discoloration.

(5) Ice Storage. Blocks of artificial ice, after manufacture may be stood on end in an insulated storage room refrigerated by means of direct expansion or brine coils. Eleven square feet of floor space may be required per ton of 400 pound blocks and 14 square feet for 300 pound blocks. Here the ice is stored at 26 to 28°F. until used.

7. Shipment of Fresh Meats. a. General. Fresh meats may be transported, chilled or frozen, unwrapped or wrapped, in containers, hung on hooks, piled on racks, in express cars, in refrigerator cars operated by packers or railroads, in refrigerator or motor trucks, refrigerated motor trailers, in wagons, ships, or other carriers, for short or long distances, during cold or hot weather, intra or interstate or beyond the continental limits of the United States.

Beef is usually shipped in quarters. For local purchases, wholesale and retail cuts and offal are included. A few market hogs are shipped but the majority of fresh pork transported is in the form of commercial cuts. Mutton and veal may be shipped in carcass form or as cuts.

b. Handling Before Shipment. (1) Storage. If meats are to be held chilled for a time before shipment, they should be kept at a temperature from 24 to 32°F. until loaded. Frozen meats are held at a temperature of zero to 10°F. until ready for shipment.

(2) Inspection. Inspection before loading is for sanitation and for compliance with purchase requirements (see "Veterinary Examinations of Fresh Meats").

(3) Wrapping and Packing. (a) Carcasses (see Carcass Beef). For local trade, mutton, veal and pork carcasses may be delivered unwrapped if clean conveyances are used. For car shipments they may be wrapped in stockinette or in muslin. Frozen stuff may be doubly wrapped with an outside covering of burlap.

(b) Meats. Fresh meats for shipment may be wrapped in paper, muslin, cheese cloth, stockinette or with an outer covering of burlap or packed in wired or strapped boxes, crates, barrels or in refrigerator boxes. Boxes may be paper lined and the pieces of meat unwrapped, or wrapped with paper or cloth. Commercial packages usually have the trade label including the brand of the product and name and address of the packer stenciled on the ends of boxes, and the name and address of consignee and gross, tare and net weights on top. Fresh meats for the Army, purchased under procurement authorities are packed in accordance with existing specifications or with the requirements of the purchasing officer as shown on the contract or purchase order. Fresh meats inspected and passed for the Army or the containers of the same should bear the marks of inspection as required by Army Regulations, by the purchasing quartermaster and such other marks or labels as are required by other official and competent inspection agencies for interstate or foreign shipment.

(4) Weighing. Fresh meats may be weighed unwrapped, or wrapped and packed with correct deductions being made for the weight of the wrappings and containers. Wherever possible, all fresh meats for the Army should be weighed without wrappings. Each empty container should be weighed separately and marked as there is a considerable variation in their weights. When fresh meats of certain averages are to be purchased, each individual piece should be weighed to ascertain if it comes within the limits of averages required. Scales should be frequently tested, at least two times in every six hours and weights checked.

c. Vehicles. Shipment by wagons or trucks usually is for short distances. The wagon or truck bed should be thoroughly clean, as

sanitary as possible and covered with clean butcher paper. The meat should be sufficiently wrapped or packed in order to protect it from contaminations by dust, dirt or other source en route. Handlers should not contaminate the bed of a vehicle or the meat with their shoes. Their frocks and hands should be as sanitary as possible. Handlers should be free from communicable disease. Inedible or contaminating substances should not be transported in vehicles used for the transportation of fresh meats. Open conveyances should be covered with a clean tarpaulin to protect meats from the sun or contamination from any source. A covered vehicle is desirable.

Meats transported for long distances in open trucks during hot weather may be wrapped thoroughly in a paraffined or waxed sheet or bag and packed in ice. Late night transportation may become desirable.

A refrigerated conveyance is best. Insulated trucks or trailers lined inside with galvanized iron and equipped with ice or brine tanks may be used during car shortage, within a radius of 100 miles.

d. Express. Fresh meats may be shipped by express for short distances. Express companies may also maintain a refrigeration service for long hauls. Some railroad companies maintain a route refrigerator service for perishable products, and fresh meats in small quantities are shipped in this manner.

Refrigerator boxes made from pine boards 1½ inches thick, with a hinged cover, and containing a smaller, galvanized iron box with telescopic lid may be used for express and refrigerator car shipments in the United States. One packer uses 7 sizes of refrigerator boxes ranging from 100 to 500 pounds meat capacity as follows:

REFRIGERATOR BOXES

DESIGNATION	NET CAPACITY	OUTER WOODEN BOX			G. I. CANS		
		Length	Width	Depth	Length	Width	Depth
	pounds	*inches*	*inches*	*inches*	*inches*	*inches*	*inches*
A A	500	34¾	22½	28½	32	19½	22½
H H	400	34¾	20	26½	30½	18	20
I I	300	34½	26	22¾	29	24	15
B B	250	30¾	17	21¾	28	15	15
C C	200	30¾	17	18	28	15	12½
D D	150	30¾	17	15½	28	15	10
E E	100	24½	14	16	21	12	10¼

Clean cans are lined with oil paper and packed with thoroughly chilled meat, fancy meats and bloody pieces as hearts being wrapped

separately in oil paper. A top liner of oil paper is put over the meats, the lid is put on, and the can set into the wooden box, the bottom of which is filled with a layer of crushed ice. Crushed ice is placed over the can, filling the box. The lid of the box is secured when it is ready for shipment.

For shipments of fancy meats less than 100 pounds and material for universities and chemical laboratories, nine sizes of ice cases may be used.

e. Refrigerator Cars. (1) General. Formerly, during winter time when cold weather prevailed constantly, fresh meats were often shipped in clean box cars without any refrigeration. For long distances, however, there was a danger of a modification of temperature and of the meat spoiling. The recently developed refrigerator car has made possible the transportation of perishable products, chilled or frozen, from coast to coast.

(2) Construction of Cars. The standard refrigerator car is a cold storage room on wheels having 4 ice bunkers in each end of the car, placed in an upright position, side by side across the ends of the car, with an opening at the top of each ice bunker and a suitable drain pipe at the bottom. Each bunker may hold 700 pounds of ice and salt or 5600 pounds to a car.

The automatic brine circulation (A B C) system differs from the standard type car in having a 3000 pound ice capacity tank located superiorly in each end. Each tank is partitioned medially in which is located a one-way check valve which permits brine to flow only in one direction. A piping system connecting the bottom of the tanks is used to circulate the brine. These pipes 3 on each side slope in opposite directions to insure gravity circulation which is accelerated by car movements when the train is in motion, but which completely stops when the train ceases to move. Drippings from condensations on these pipes are removed by troughs.

Refrigerator cars for meats are made as air tight as possible, insulated with matched lumber, dead air space, building paper and hair felt. The hatch plugs and doors are so constructed as to produce an air tight contact when closed. Light colored external paints reflect the sun's rays while dark colors absorb them. Therefore, light colored paints are desirable on refrigerator cars to reflect the sun's rays. The ice bunker tank car is preferred by some to the open air bunker type.

The brake end of a car is known as the "B" end. The opposite end is the "A" end. The "Right Side" is the right side of a car, facing the A end. The "Left Side" is the left side of a car, facing the A end.

(3) Inspection. At loading, the veterinarian should be equipped with a good, efficient flash light and a standard, registered Fahrenheit thermometer to ascertain car temperatures. He should examine the condition of car equipment as to suitability and state of repair. The car doors should be well insulated and tight fitting. The floors should be properly racked with clean, well made racks four inches from the floor and in proper state of repair. All drain pipes from open style bunkers should be open to prevent bunkers from overflowing, flooding the floor and saturating meat piled on floor racks. Hooks should be clean, free from rust or contamination and well tinned. The interior of the cars should be clean, dry and as sanitary as possible. There should be no foul or foreign odors. A car should not be loaded with chilled beef if it has a temperature of more than 38°F. For frozen meats the temperature of the car should be below freezing. The clothing and hands of beef luggers and other meat handlers should be clean and sanitary.

(4) Precooling. Precooling of refrigerator cars for the shipment of fresh meats is essential or the refrigeration of the car will be at the expense of the meats, resulting in defrosting of some portions of frozen products with subsequent deterioration. Precooling may be accomplished by properly icing cars using a sufficient quantity of No. 2 rock salt and allowing plenty of time prior to loading, to reach the desired temperature. In winter it takes less time to precool and, during very cold weather, precooling may be accomplished by proper icing of the bunkers and opening the car doors. Cars may be received which have just been unloaded and which are at a desired low temperature. Such cars after proper icing may be used without any delay. Warm cars in hot weather may require twenty-four or more hours to precool.

A standard refrigerator car in good repair under ordinary temperatures and properly iced with crushed ice and 15 per cent of No. 2 rock salt, twenty-four to thirty-two hours prior to loading, may have a temperature of 26 to 28°F. at the end of that time.

Properly crushed ice is from the size of an egg to that of a man's fist. If too large it will not pack tightly enough, if too small, it may pack too tightly. Some cars are not constructed so as to admit of the use of crushed ice. When this obtains, the bottom layer in the tank should be cake ice and the balance, properly crushed ice with a mixture of 15 per cent No. 2 rock salt and properly tamped. Ice may be properly crushed in mechanical crushers and conveyed to the cars

by means of trucks, tram trucks, wheelbarrows, chutes, buckets or by other means.

No. 2 crushed rock salt, with pieces one-eighth to one-fourth of an inch in thickness is generally used. Salt should be thoroughly mixed in the ice mass in the bunkers. It may be discharged into the icing bucket or truck before it is emptied into the ice bunkers where the salt becomes uniformly mixed throughout the ice, or, salt may be added as the ice is poured into the bunkers.

The ice should be tamped down well and bunkers completely filled, then the hatch plugs closed tightly to prevent escape of refrigeration. By the melting of the ice, refrigeration is produced by absorption of heat as its latent heat of fusion. The denser the resulting brine the lower will be the refrigeration obtained.

Cold brine may be placed in containers set in the car to aid in the precooling process. Another method consists of cooling cars in a few minutes time at the loading dock by means of air conducted from a chill room or freezer, through ducts.

(5) Loading. Loading may be conducted on refrigerated loading docks fitted with doors. These doors may be opened and canvas vestibules used to fit to the sides of the cars at time of loading, to conserve refrigeration. When loading on open docks during hot weather, split canvas covers may be used over car doors to prevent a loss of refrigeration.

In cars, chilled carcasses should be hung on hooks or strong cords and should never come into contact with the floor. Floor racks on which frozen carcasses and boxed meats are piled should be slatted for air circulation and have at least 4 inches of clearance from the floor. In mixed shipments, fresh sausages, pigs' feet, neck bones, spare ribs and edible organs are more perishable than cured meats, smoked sausages, lard and other prepared products, and for that reason should be placed at the bottom and ends of cars where the temperature is lowest, to prevent spoilage. Carcasses, parts and packages should be so hung or placed as to insure free air circulation underneath and overhead, otherwise refrigeration would be retarded. Wooden cleats or strips should be placed between each layer of boxes.

Refrigerator cars have a gravity, air circulation only. Dense, cold air flows downward from the surfaces of the ice bunkers, through the lower portions of the car and under the floor racks. As it becomes warmed a few degrees from contact with the floor, products and sides of the car, it is forced upward and returned overhead to the bunkers

for cooling. To protect the bunkers from the load and to augment proper air circulation, a wooden apron is hung in front of the bunkers at each end of the car leaving a space above and below each apron to allow a free circulation of air. Plenty of head room should be provided for the return flow of warmed air to the ice bunkers.

The cars should be loaded to capacity whenever possible. When not being loaded, the car doors should be closed. After the car is loaded, a check sheet is tacked on the inside of the car door with the seal numbers, then the car doors are closed and sealed. Inspection should be made to see that the car doors are tight. Canvas strips on car doors may be used as an aid to maintain refrigeration. Each car is then re-iced as described in paragraph (6). Shipping orders and bills of lading should be examined to ascertain that they contain instructions for daily icing adequate to insure arrival of the meat at its destination in good condition.

(6) Re-icing. Refrigerator cars containing either chilled or frozen meats should be properly re-iced every twenty-four hours at regular re-icing stations en route, using crushed ice and 15 per cent of No. 2 crushed rock salt. Arrangements should be made for re-icing when regular icing stations are not available. For short distances requiring not more than twenty-four hours, the initial icing at loading may be all that is necessary. Car temperatures for shipping chilled meats should be from 32 to 36°, and for the safe transportation of frozen meats the temperature should be maintained below the freezing point (i.e. below 28°F.) to keep the meats in a frozen condition. Car doors, however, should not be opened except at destination.

To re-ice fresh meat cars in transit, care should be exercised to remove all dirt and cinders from the hatch plugs before raising them, to prevent any foreign material entering the ice tanks as it would be liable to cause a stoppage of drain pipes. Only one tank should be opened at a time. The ice chambers should be examined to see if they were properly re-iced at the last icing station. The tank should be re-iced at once. To leave it open longer would be to lose refrigeration. The excess brine should be drained off through the drain pipes.

The ice tanks may appear to be full, or nearly so, when in reality the lower ice in the tanks has melted away, leaving only a crust of ice frozen to the sides of the tanks. This old, encrusted ice is poled down into the bunkers by means of a blunt, wooden, tamping pole. Sharp or steel shod poles are liable to cause injury to the ice tanks and should not be used. The pole after being worked down to the bottom of a

tank, is given a rotary motion, breaking up the encrusted ice cap which is then tamped to the bottom.

Ice alone will not produce a temperature sufficient to preserve meats. It is vitally important that No. 2 rock salt in the quantity instructed on the billing is used with the ice. One-third of this salt should be added to the old ice before filling the tanks with new ice.

Ice should be free from dirt, hay, straw, chips, sawdust or other foreign matter likely to choke drain pipes. Where power ice crushers are not used, good results can be obtained by pounding up ice in a crushing box using a wooden maul. Under no condition should ice be broken on the top of the car.

After filling the tanks with properly crushed ice, the remaining two-thirds of the salt is added. The final tamping is then given with a blunt tamping pole. This mixes the salt and gives it a start through the ice and prevents the possibility of a solid cake freezing on top and failure of the salt to work down through the ice as intended. The hatch plugs should be replaced immediately and pounded into place with the tamping pole or by being jumped on.

This re-icing should be repeated every twenty-four hours whether in transit, standing on a siding or at destination, until the car is finally unloaded.

8. Veterinary Examinations. a. Scope. (1) General. The veterinary examinations of fresh meats intended for troops, including both sanitary and procurement inspections, begin with a consideration of the sanitary source of such products, at time of purchase of live food animals by the Government; sanitary ante-mortem and post-mortem examinations; or the initial inspection of carcasses, cuts, offal and trimmings, their selection, grading for quality, condition, weight and the supervision of the sanitary requirements of slaughtering, butchering, dressing, branding, chilling, trimming, boning, defrosting, covering, packing, stamping of packages or other manipulation, handling, storage, shipment, receipt and issue, with such reinspections as are required. It also includes the sanitary location, construction, equipment and methods of operation of all meat establishments as defined in Army Regulations, the health and sanitation of personnel involved, and freedom of all compartments from contaminating agents as animals, vermin, dust or other substance.

(2) Sanitation. All establishments wherein fresh meats are produced, handled or stored should comply with the sanitary requirements of the Surgeon General as outlined in Army Regulations (see

Chapter III—Handbook). Compartments should have properly constructed walls, floors and ceilings in a good state of repair, adequate drainage, ventilation, air circulation and light. Equipment, machinery implements and facilities should be sufficient, sanitary and properly constructed with appropriate materials used in their manufacture. Methods of operation include supervision, cleanliness in handling and processing products and the sanitary cleanliness of tables, benches, cutting blocks, chutes, trucks, knives, saws and meat hooks. Personnel, whether supervisory, employes, visitors or inspectors of any kind, should be free from communicable diseases, open wounds on hands or fingers and from filthy habits. Their clothing and person should be clean. All meat handlers should be instructed thoroughly in the sanitary requirements. Compartments should be free from rodents, roaches or flies. Water and ice used should be of unquestioned purity. Only authorized products and ingredients should be handled or stored, and approved sanitary processes employed in any part of an establishment.

(3) Inspection of Products. (a) General. This includes the inspection procedures required by the Surgeon General, and, when, purchased under procurement authorities, such other examinations as may be required.

(b) Sanitary Examinations. *Scope.* The sanitary examination includes evidence of prior official inspection, sanitary handling and storage, freedom from all unsoundness as contaminations, discolorations, injuries, diseased or parasitic conditions, deteriorations and adulterations, and from physiological defects.

Organoleptic examinations consist of the use of the senses of sight, smell, touch, taste and rarely hearing and are one of the best and most practical means of judging unsoundness. Veterinarians should be familiar with the appearance, color, odor, flavor, consistency and resistance of various kinds of normal fresh meats, as experience is of first importance in forming a judgment.

When special senses are disturbed, blunted, lessened, sub-normal, perverted, diseased or abnormal, a correct opinion of a product may not be obtained. Most users of tobacco or of alcohol in excessive quantities, have perverted senses of taste and smell. "Off" odors may not be detected in some instances of coryza. Very hot or cold substances may be tasteless. Cold inhibits the tactile sense.

The appearance of a package or product may indicate conditions of prior handling. Color of fresh meats depends mainly upon kind, age,

conditions at slaughter and part of the carcass from which derived. Meat should have a good normal color, neither too pale nor too dark and should be free from any abnormal odor. Decomposed meat may be detected if it has a strong, sour, disagreeable, musty, mouldy or other off odor. Putrid odors are usually due to ammonia or hydrogen sulfide. Rancidity of fats may be determined by the odor or flavor. A steel trier or knife may be used as an aid in the examination for odors. Sound meat from properly slaughtered animals, which has been handled and stored in a sanitary manner, should be reasonably firm to the touch and should barely moisten the finger. Meat should not be flabby or pit on pressure.

Field and Laboratory. The modified Eber's test for putrefaction, as outlined under the inspection of frozen carcass beef on receipt, and other simple tests may be conducted in the field. For laboratory examinations, meat samples should be collected, handled and forwarded to Medical Department Laboratories in accordance with Army Regulations. Microscopic and histological examinations are of little value but sometimes necessary. Chemists tests are of value to determine the amount of hydrogen sulfide and of ammoniacal nitrogen, rancidity, free fatty acids and adulterations. Bacteriological examinations, qualitative and quantitative, and feeding experiments may be conducted.

(c) Inspections for Purchase and Conservation. Simultaneously with the inspections for soundness and sanitation there is maintained such examinations at purchase or subsequent thereto, as is required by the purchasing and issuing officers. The defects to be looked for, both sanitary and in specification requirements, are usually detected in the same veterinary inspection. No inspection for specification requirements is contemplated which does not include simultaneously an investigation of sanitary conditions, and the two inspections overlap and blend in essential features. Nevertheless, sanitary inspections are more comprehensive and must be applied repeatedly to the same products in order to insure the continuance of the conditions found to be correct when the supplies were originally procured. Sanitary inspections of supplies are therefore required while they are in storage, or when they are shipped, issued, or sold, when the question of specification requirements is not under consideration.

b. Inspection after Slaughter. After slaughter, the veterinary officer should ascertain that all inedible or rejected portions have been removed from carcasses, parts, organs, fats, and trimmings, and that

passed meats are thoroughly washed, drained, or dried, and properly stamped. A reinspection should then be given to determine the presence of contaminations as fecal, urine, floor, pus; or, of hides, hoofs, hair, scurf, foreign bodies, blood clots, bruises, abscesses, parasites, and mutilations.

Food carcasses set aside for further examination or parts requiring treatment by chilling or refrigeration should be held apart from inspected and passed meats or products. This includes those suspected for icterus or sexual odor, fresh pork intended for consumption without cooking, and beef carcasses refrigerated for measles.

c. *Inspections prior to Purchase.* The inspection prior to purchase is the inspection made during manufacture or when the supplies are offered for sale to the Government at purchasing points, at stations or in the field.

d. *Inspections during Shipment.* (See section 7.)

e. *Inspection on Receipt.* This is conducted whenever or wherever fresh meats are acquired or accepted, as purchased by troops directly or by a supply officer; by shipment from a supply officer to a storage or issue point, at shipside, and is maintained at purchasing points, at stations or in the field.

Fresh meats should receive a piece inspection on receipt for marks of prior official inspection and for soundness, also, if purchased under the purchasing officer, such examinations as are required or as may be covered in War Department specifications. This inspection on receipt would include local purchases (see Station Service) and postmortem examinations of bona fide farmer killed carcasses (see Cattle Slaughter).

The veterinarian of a station should recommend the issue and enforcement of a station order covering the inspection of local purchases, outlining the requirements and specifying the particular building or place as the only point of entrance of food products of animal origin to the command. The supplies are here inspected at a specified time, passed or rejected and all supplies inspected are appropriately marked or stamped by the inspecting veterinarian, irrespective of prior inspection or stamping. This order may include the use of military police, coöperation with the sanitary officer inspecting messes and with local or state health authorities, and the stamping of invoices.

When a refrigerator car shipment of fresh meat or other products of animal origin is received at a military station or other point, the veterinarian should make a thorough examination and record his observa-

tions. An inspecting veterinarian should never depend on memory, but all returns and reports should be based on notes made at the time of inspection. He should record the date of receipt, date and time of inspection, date unloaded, type of car, car initial and number, name of railroad or transportation agency delivering the car to the station, correct name of individual or firm supplying the products and their correct postoffice address, condition of the seals and the condition of the car and car equipment. Drain pipes should be reported as open or closed, hatch plugs as in or out and the amount of ice in the bunkers as full, $\frac{3}{4}$ full, $\frac{1}{2}$ full, $\frac{1}{4}$ full, $\frac{1}{8}$ full or empty.

The condition of the interior of the refrigerator car and the hooks and hangers with regard to cleanliness; the condition of the load and containers; the manner in which the meat is loaded; the arrangement of packages and the temperature of the car, should be ascertained before the meat is removed. Evidence of apparent carelessness or neglect in regard to shipping or handling should be recorded and reported through channels to the Surgeon General of the United States Army. A similar examination as far as applicable should be given conveyances as motor trucks or other vehicles delivering meats to a station.

Marks of prior official inspection, the number of pieces or packages and the net weights should be recorded. The surface of chilled meat should be examined for soiling or other evidences of careless handling. Mould, bruises, decompositions and other abnormalities should be looked for. An indication of insufficient refrigeration is a slimy condition which is likely to appear in the fold of the flank, on the neck and on cut surfaces. In chilled quarters of beef a meat trier may be used to detect bone or joint sourness and decomposition.

Upon receipt of frozen meat the veterinarian should observe marks of prior official inspection, covering, cleanliness of the product and give as thorough an examination as possible for diseased conditions. The examination of frozen meat as to lymph nodes and color, to be properly done would require its being thawed out. As a rule, this is not a practical procedure. In case of imported Australian beef, an examination should be conducted for "worm nests" (nodules produced by the Oncocerca gibsoni). When frozen carcasses or parts are covered with cloth wrappings, piece inspection is not practicable except at final destination, however, the firmness of the meat and the condition of the surface as to dryness can be determined to a certain degree without removing the covering. When frozen meat is exposed

to a comparatively high temperature, the surface thaws and becomes soft, moist or slimy. If softness or moisture is discovered, the carcass or part should be uncovered and cut through to determine the exact condition.

The inspection of fresh meats for purchase, at destination includes selection, grading for quality, condition and weight paying special attention to specification or other purchase requirements, color, trimming, soundness, covering, weighing, marking, storage and handling.

f. Inspection in Storage. (1) Defined. By the term inspection in storage is meant the inspection of food supplies subsequent to their procurement or acceptance and prior to their issue or prior to shipment from one station to another. These supplies by reason of their tendency to undergo deterioration and harmful changes, rendering them in part or in whole unfit for food purposes, should be examined at frequent intervals from the time of their receipt at a storage place. All such inspections are of the nature of reinspections of the extent and thoroughness required by existing conditions. Inspection in storage is practically limited to the service at supply depots and at stations.

The inspection of surplus stores the sale of which to the public is contemplated is a special procedure. The supplies may require interstate shipment and the rules of the United States Bureau of Animal Industry applicable to civilian shippers and dealers in like cases must be complied with in all respects.

(2) General Sanitary Inspections. Storage of fresh meats at destination as at camps, posts, other military stations or in the field may include cold storage rooms, coolers, refrigerators, refrigerator cars, butcher shops, markets, or other places or compartments, operated under widely varying conditions. Fresh meats are very perishable products which are subject to rapid deterioration and decomposition unless stored in sanitary compartments or containers under the best of conditions.

The frequent sanitary examination of such storage places and of the products devolves upon the Veterinarian, except mess and restaurant refrigerators or other compartments containing fresh meats after issue and which come under the inspection by the general sanitary service of the Command. These examinations should be made daily (see Chapter III), notation made of storage temperatures and of defects and such recommendations and reports made as are necessary.

(3) Storage in Cars. When refrigerator cars containing fresh meats are received at destination, they should be unloaded as soon as practicable provided adequate cold storage facilities are available. If not unloaded, the ice bunkers should be examined and the cars properly re-iced to capacity every twenty-four hours using 15 per cent of No. 2 rock salt, the doors kept closed as much as possible and a canvas curtain used over the doors to prevent loss of cold air. A standard, registered thermometer should be placed in the car about 4 feet above the floor and temperatures frequently recorded. Carcasses remaining in the car should be well spread out and shifted from time to time in storage to permit of free air circulation.

If meats which have been properly chilled and handled, are removed from refrigerator cars on receipt and placed into a cooler kept at 34 to 36°F., they should last at least eight to ten days. When kept after receipt in refrigerator cars at 50 to 60°, they may not last over three days If unloaded into a summer temperature of 100°, ten hours will be as long as it reasonably can be expected to keep fresh meat in fit condition for human consumption.

(4) Local Commercial Establishments. (a) Sanitary Inspections. Proprietors or operators of local butcher shops, retail or wholesale markets, abattoirs or other establishments who propose to supply food products of animals origin to any station or command should apply in writing to the commanding officer thereof for Army Veterinary inspection regarding the suitability and sanitary condition of their establishments, their animals, products, and the source from which the supplies to be delivered, are derived. When granted, the initial sanitary inspection of an establishment is conducted by the station veterinarian and includes a survey of the plant and premises to ascertain whether the same are in a sanitary condition (see Chapter III) and whether facilities necessary to a proper conduct of subsequent routine veterinary examinations can be provided. The veterinary officer then should indicate to the proprietor or operator what changes or additions should be made for the correction of insanitary defects, if such exist in or about the establishment, specify the kind of inspection facilities to be furnished and arrange for a complete separation of officially inspected and passed products from those which are non-inspected or which may be rejected. When the establishment has been placed in an acceptable condition, the station veterinarian recommends to the commanding officer, through the surgeon that the application for official veterinary examination be approved and such in-

spection of the establishment and products be granted. Such establishment so long as it continues to be a source of supply for the command, should thereafter be frequently inspected, such recommendations made as are necessary from time to time and such record and reports made as required.

The inspection and supervisory work of the Bureau of Animal Industry, United States Public Health Service, or other recognized competent sanitary agencies in local establishments need not be duplicated when reports of these inspections containing the necessary information are available and where the standard maintained is satisfactory to the station veterinarian and the surgeon, and approved by the commanding officer; with these exceptions, inspection requirements should be applied to establishments selling officially inspected food supplies, and all such supplies should in any event be subjected to veterinary inspection on delivery at the station.

When an establishment is not properly operated or does not maintain a satisfactory standard of sanitation, and correction of these defects can not be obtained after the matter has been properly brought to the attention of the proprietor or operator, written recommendation should be made by the station veterinarian, through the surgeon, to the commanding officer that its products are excluded from the command.

(b) Abattoirs and Small Packing Houses. The general sanitary requirements are contained in Chapter III. The inspections of fresh meats locally may include ante-mortem, post-mortem and products inspection, and their delivery to the command.

Ante-mortem Inspections. The station veterinarian makes so far as practicable an ante-mortem examination of animals from which any meat or meat product is to be offered for the use of the command. If upon such an examination an animal is found to be affected with any disease or condition that may render its meat in whole or in part unfit for human food, such animal should be excluded from the lot of animals to be slaughtered for the use of troops. All animals which are sound and fit for food so far as can be determined by the antemortem examination may be passed for further inspection at the time of slaughter.

Animals bought on the hoof are inspected by a veterinary officer whenever one is available, preferably prior to acceptance, and always prior to slaughter and subsequent thereto. When practicable, live animals should be accepted for purchase subject to veterinary ante- and post-mortem findings.

A veterinary officer when present is called on to act in an advisory capacity in the interpretation of Government specifications for animals purchased in the field. (See Chapter IV.)

Post-mortem Inspections. The post-mortem inspection is made as soon as practicable after slaughter and should be thorough and complete. When disease or abnormal condition is found at such inspection the veterinary officer determines the fitness or unfitness of the meat in accordance with prescribed standards. Any carcass judged to be other than sound and fit for human food should not be approved for the use of troops. (See Chapters V and VI.) All passed carcasses of other products should be stamped in accordance with regulations.

Products Inspections. Products inspections following the prescribed procedures will be carefully made, and an examination of the finished products is required on delivery at a station. When such products are to be acquired by a supply officer, inspection for compliance with specifications should be included.

(c) Meat Markets and Butcher Shops. Meat markets and butcher shops should be conveniently located for inspection and have sanitary surroundings. Outside displays should not be permitted as more or less dust, dirt, fly or other contamination will result and which augment decomposition changes. All markets should be properly fly-screened. Inside, window displays should be screened and if possible kept under refrigeration. Counter displays should be screened against flies and handling. Sanitary, glass display cases are more desirable, preferably under refrigeration. The floors should be dry and clean. When sawdust is used on floors it should be clean and frequently renewed, however, sawdust may be productive of dust. Walls and ceilings should be free from cobwebs, dusty ledges and old festoonings. The butcher blocks, tables, counters, knives, saws, scales, and sausage grinder may become highly contaminated if not frequently and properly cleaned. Tables should be tightly constructed and free from cracks. It is not a good plan to have uninspected meats in a butcher shop granted Army inspection as they may be piled on tables with inspected products, run through the meat grinder which is used for inspected meats, or otherwise handled and divided with implements used for Army products. This may result in contaminations of inspected meats and of apparatus, from diseased or unsound uninspected products, also the identity of uninspected products cannot always be preserved and such may be included along with inspected meats. Butchers should wear clean, white aprons or other sanitary

clothing and should be required to have any cuts on fingers treated with a surgical dressing which is then covered by means of a clean, leather fingerstall. Iodoform or other malodorous dressing materials should not be used in this treatment. Cats and dogs should be excluded from markets. The sliming of casings, slaughter of small stock or of poultry in a butcher shop or its basement is not desirable. Scrap boxes should be sanitary and proper disposition made of all scraps and rejected products. Old, tainted pieces of meat should not be put into cure for bologna but should be rejected. Unauthorized preservatives, dyes and rat or other poisons should not be permitted in butcher shops.

In ice-box or cooler inspection, a veterinarian should be equipped with a flash light in good working condition. Ice boxes and coolers should be properly constructed, with vestibules installed if necessary. They should be well insulated and have adequate ventilation, air circulation and lighting facilities. A standard, registered thermometer should be suitably located. The doors and inside surfaces should be smooth, clean, free from mold, dry and painted with a good, white paint which will not scale off. Whitewash is not desirable. Floors should be dry and covered with clean sawdust which is renewed frequently. Hooks and racks should be cleaned with boiling water and a brush at least once a week and more often is necessary. Drain pipes should be clean and in proper working condition. Malodorous cheeses, fish, and mouldy, overrippened, decomposed, rejected or other undesirable products as vegetables, fruits or other substances, should not be stored in ice boxes or coolers. Inspections should include a detailed consideration of the products, marks of prior official inspection, cooler age, decomposition or other changes, contaminations, handling and other storage features. Such trimming as recommended by the veterinarian should be expedited. In this work coöperation should be maintained with local health authorities.

(d) Small Refrigerators. A small refrigerator should be desirably located, preferably away from the heat of stoves or radiators, in a room which is maintained in a sanitary condition. It should be cleaned every day and well iced. Doors should be kept closed at all times to conserve refrigeration. Meats should not be stored in the ice compartment and never in contact with ice as the ice may not be clean, the meat will become wet which hastens spoilage and the meat juices may be dissolved and befoul the compartment and drain pipe. Drain pipes should be sanitary and open. Food compartments should not be overcrowded and meats should not be so placed as to occlude or

retard air circulation. At 55°F. it is possible to keep good, fresh, dry meat twenty-four to thirty-six hours; at 45° three days or more; while above 57°, the refrigerator is inefficient. A good thermometer should be employed in each refrigerator.

g. Inspection at Issue. The inspection at issue to troops is the final veterinary inspection given food supplies at or shortly before their issue, is essentially for soundness, and pertains entirely to the service of stations and in the field. It is similar to the inspection in storage, but is more detailed and takes into consideration the fact that the supplies have reached the point of ultimate disposal. So far as practicable, it is a piece inspection. The adaptability and cleanliness of vehicles used for transporting fresh meats and the methods of handling up to the point of delivery to organizations come under this inspection. At issue, fresh meats should be handled as quickly as possible and under the same general requirements as covered in "Inspection at Issue—Carcass Beef."

h. Action. When officially inspected meats received by, or offered for sale to, a quartermaster are found on delivery to present any sanitary defect they should be rejected.

In the unusual event that it is necessary to meet the immediate needs of a station, such meats received by, or offered for sale to, a quartermaster, found on delivery to be affected with an unsoundness of slight or limited extent, which in the opinion of the veterinary officer can safely be removed by trimming, wiping, or other manipulation, the treatment which the latter considers advisable should be recommended to the quartermaster and, after such treatment has been applied, a reinspection should be made, and if the defects have been removed acceptance is permissible provided that the use of the supplies for food does not constitute a menace to the health.

In the case of inspected meats in the possession of a quartermaster found to be affected with an unsoundness of slight or limited extent which in the opinion of the veterinary officer can be removed by trimming, wiping, or other manipulation, the treatment which the latter considers advisable should be recommended to the quartermaster and, after such treatment has been applied, a reinspection should be made.

Meats in the possession of a quartermaster which are found by the veterinary officer to be unsound or otherwise unfit for food purposes and consequently unsuitable for issue, either in part or in whole, should be reported to the quartermaster for survey.

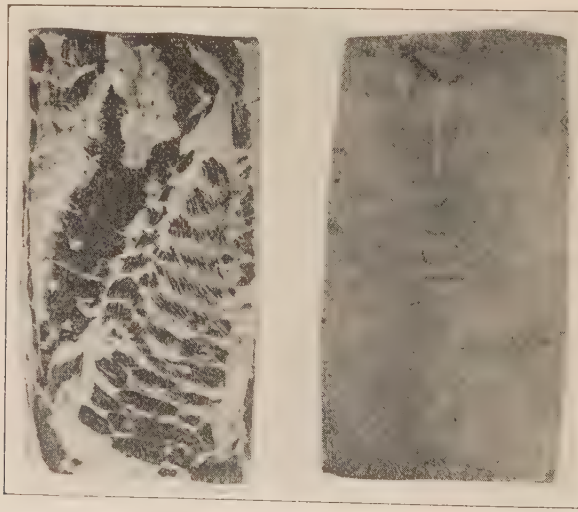
When meats offered for the use of troops are rejected because their use would constitute a menace to health, the station veterinarian should endeavor to secure the consent of the owner to denature or destroy them; in case consent is secured he should see that they are properly disposed of. If the owner refuses his consent, indicating a purpose to dispose of the unsound product elsewhere, the veterinary officer should, through the commanding officer, notify the local health authorities and, if proper disposition can not be obtained by this method, recommendation should be made to the commanding officer that permission to supply meats and meat food products to the troops be made contingent upon the proper inspection and disposition of articles rejected as unfit for food by the veterinary officer. In order that the purpose of inspections may not be defeated, the exclusion of the troops from public eating places should be recommended whenever such places purchase or serve supplies which have not been properly inspected or which fail to meet inspection requirements.

CHAPTER IX

Products Inspection (continued)

C. CURED MEATS

1. General. a. Cured Meats, Defined. Cured meats are those preserved with authorized chemical substances in dry form, in solution or in the form of wood smoke, either singly or in combination, to improve their keeping qualities. Desiccation by means of solar or produced heat or by concentration also may be used. As discussed



(Permission Wilson and Company)

Fig. 47. Army Bellies, Fresh

in this section, cured meats include pork, beef, mutton and veal; wholesale and boneless cuts of the same, trimmings and offal. Curing as applied to sausage, fish, eggs, or other products is considered under appropriate chapters.

Curing agents may be applied to the surface of whole pieces of chilled meat or hashed into the meat (except smoke). Whole pieces may

be pumped with concentrated salt brine directly into the meat or through injection of blood vessels. Meats may be cured in chill rooms or in some instances, heated, to "force" the cure. Small products may be churned with curing solutions or mixtures to expedite curing.

The preservation of meats by the use of salt is a very old method and is universally used. Herodotus, who lived 475 B.C. is quoted as saying of the Egyptians, "They live on fish, raw, but sundried or steeped in brine; they eat also raw quail and ducks and the smaller birds, salted beforehand." Salt is readily soluble in water, quickly penetrates fat and lean by osmosis and diffusion, imparts a gray color to the flesh, inhibits bacterial growth and produces a salt flavor. Saltpetre is used to fix the red coloring substance in meats. Sugar is used in curing the better grades of meat to offset saltiness and to furnish a medium for bacterial growth with development of flavors. The general principles of curing are the same, the methods of application vary greatly.

b. Ingredients Used (see Chapter VII). (1) Authorized condimental antiseptics which may aid in the preservation of fresh meats and impart directly, or indirectly through bacterial and enzymatic action, desirable flavors to meats, include salt, saltpetre, sugar, vinegar (except wood vinegar), spices and wood smoke. Water is sometimes employed as a medium for curing agents and for washing cured meats.

(a) Salt. NaCl may be produced from sea water or waters of salt lakes, inland seas or of salt springs, through solar evaporation in large reservoirs, or by heat evaporation in large kettles or pans. Sea water contains $\frac{1}{4}$ pound of salt per gallon, water of the Great Salt Lake, Utah, $1\frac{1}{3}$ to 2 pounds, and that of the Dead Sea 2 to $2\frac{1}{2}$ pounds. The salt resulting from these methods of evaporation is usually more or less coarse, flaky and impure and is used to salt fish or to make brine pickles.

Rock salt with pieces ranging from fine dust to large lumps is mined and dumped over "riddle" bars where the large pieces are separated out. These are sorted, piled to season then sold as lump, rock salt. When first mined, salt is very brittle but upon exposure to air, it toughens, therefore it is carefully handled and stored until aged. The remainder of the salt is crushed between rolls, passed over shaking screens where it is separated out into various sized crystals, then weighed out into different sized sacks for shipment. Some rock salt may be used without refining. Rock salt is used principally for refrigeration purposes, and for preserving hides. Rock salt includes both lump rock salt used for live stock and crushed rock salt. Crushed rock salt may

be produced in many grades. No. 1, 2, 3, 4, 7, "C. Fine" and "Packers' Fine" grades are generally used. No. 1 crushed rock salt has grains the size of wheat kernels and is used for salting hides and in freezing mixtures. No. 2, the grade most used consists of cubes $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter and is used for making brines, salting hides and in refrigerator cars. No. 3 is a coarse salt, with pieces more than $\frac{1}{4}$ inch in diameter and is used in refrigerator cars. No. 3 capping salt is a white, clear rock salt used in barreled beef and pork curing. No. 4 is as fine as coarse grainer salt and is used by stockmen. "C. Fine" include grades from No. 1 on down. No. 7 is about $\frac{1}{16}$ to $\frac{1}{8}$ inch in diameter. "Packers Fine" is the finest grade made and is principally used in packing pork and beef.

Instead of mining rock salt, a hole may be drilled down to the bottom of a salt bed, casings and an inner pipe tube inserted and pure fresh water introduced to form a saturated brine which is pumped out into large settling tanks. At 60°F. fully saturated or 100 per cent brine contains 26.47 per cent salt or about $2\frac{2}{3}$ pounds per gallon. The brine is allowed to settle twenty-four hours in large settling tanks to precipitate out the insoluble impurities as gypsum and sand. The brine is then run into large vats heated by means of steam coils, where the soluble impurities are removed. It is then ready for evaporation either by the "Grainer" process or by the vacuum pan method.

In the grainer process, long, steel, wooden or cement troughs are kept filled with brine which is heated by steam pipes suspended a few inches from the bottom. The precipitated salt which results from evaporation is raked out automatically, drained, and sent to a warehouse where it is stored and cured. When the brine is heated to 110°F. large grained salt is produced, when heated to 165°F. common salt, and, if heated to 225°F. fine salt. Grainer salt crystals are large, flaky, cling together and dissolve quite rapidly when dropped into water. This salt is known as grainer, medium, common, fine or steam salt and is the basis of butter, cheese and meat salts.

In the vacuum pan method, even cubes crystallize out and settle to the bottom of the vacuum pans. The salt is removed, dried in bins three weeks, graded, separated and packed into barrels, sacks or cartons. Vacuum pan salt crystals are fine, regular, and cubical in formation having the appearance of granulated sugar. It is sold as granulated or table salt.

Vacuum pan, grainer or solar salt may be steam, kiln-dried in ten to twenty minutes with a reduction of its moisture content to a frac-

tion of 1 per cent. The dried salt is then conveyed to a mill where the "flour" is removed by a blower and the salt is sifted through a screen having four different sized, steel-wire meshes ranging from 34 to 18 per inch. No. 34 mesh salt is a very fine, table salt; No. 30 mesh, ordinary table salt; No. 24 mesh, a coarser grained "butter" salt, and No. 18 is known as "No. 1 Kiln-Dried" salt. The purpose of kiln drying is to prepare salt for manufacturing purposes and for table use where it is essential that moisture be eliminated, and where the salt will flow easily.

Free running salt may be produced by mixing in a "filler" or "dryer" such as sodium bicarbonate (to a fraction of 1 per cent) then subjecting the mixture to heat, which with the moisture content of the salt causes the soda to eliminate its gas and to coat each of the salt cubes with soda thereby protecting them from moisture and insuring a free running salt. To test for filler. pour some of the salt into a dish held about 2 feet below the salt container. The filler if present will float away from the stream of salt as a white cloud or streak. Another test consists of pouring a sample of the salt into a clean, dry hand then emptying the hand. Should filler be present, a fine dust may adhere to the palm and when tasted will be free from salt flavor.

Salt should be stored in a clean, dry compartment and should not be contaminated from dirty floors, boots, utensils, vermin, splashing, water or other objectionable agencies. Second salt is discussed under dry salt pork cuts. A sanitary inspection should be given all salt used in curing, including its handling and storage. Impure, grayish, bluish, stained or contaminated salt is not desirable for use on or in edible products.

Salt inhibits but does not prevent the development of microörganisms which may abound in large variety in curing mixtures, saturated or other pickles or cured meats at chill room temperatures, however, under these conditions of low temperature and of high salt concentration the chemical activity of bacteria is greatly lowered.

(b) Saltpetre. Potassium nitrate and sodium nitrate may be used in curing mixtures and solutions. Sodium nitrate (Chili saltpetre) is about 16 per cent stronger in action than potassium nitrate (India saltpetre) and 84 parts of the former will have the same effect as 100 parts of the latter. The action of saltpetre on flesh is described under corned beef.

(c) Sugar. Sugar used for curing purposes may be cane or beet sugar, raw or refined or in the form of molasses, honey or other ap-

proved sweetening agent. United States Standard sugar is white sugar and must contain at least 99.5 per cent of sucrose. Granulated sugar may contain 99.8 per cent of sucrose, centrifugal sugar 92 to 96½ per cent, beet sugar 91 to 95 per cent, brown sugar (the best grade of muscovado or raw sugar) 84 to 87 per cent, refiners' syrup 56 per cent and under, and molasses 30 to 50 per cent.

Damp, sour, fermented, musty, mouldy, contaminated or adulterated sugar; or that with a rumlike odor or flavor, or containing iron, starch, chalk, dirt, sand, debris, ants, flies, mites or cockroaches, should not be used for curing purposes. An ash content of more than 6 per cent in syrup will impart a bitter flavor to cured products. Sugar storage rooms should be properly located, of good construction, well ventilated, dry and free from vermin and malodorous substances as paints oils, etc. Sugar should be piled away from walls and off the floor preferably on 6 inch dunnage, to prevent moisture damage.

(d) Vinegar. Authorized vinegars are those produced by acetic acid fermentation of alcoholic liquids as apple cider, wine, malt or spirit and of sugar or glucose; containing at least 4 grams of acetic acid per 100 cubic centimeters; and free from dilution, substitution, metallic salts, arsenic, wood vinegar, caramel, spices or other adulteration or undesirable substances. 100 grain vinegar means 10 per cent, i.e. it is equivalent to 10 grams of absolute acetic acid in 100 cc. 1 gallon of 100 grain vinegar contains about 0.833 pounds of absolute acetic acid. Wood vinegar which may be prepared by purification of proligneous acid is not authorized and should not be used.

Vinegar containing vinegar mites, lice or flies; showing an excess of precipitate, cloudy or having a pronounced, objectionable odor or flavor, should be rejected without laboratory analysis. Vinegar made from decayed apples should be rejected. Vinegar stored in containers previously used for oil, gin or mustard may acquire objectionable odors, or such may be due to decomposition of immense numbers of vinegar eels.

Vinegar should be transparent, clear, without artificial coloring and without any pronounced odor other than that of acetic acid. Vinegar should be stored between 40 and 50°F. and away from direct rays of the sun.

(e) Spices. Bay leaves; black, red or paprika pepper or other pungent condiments or spices should be fresh, pure and free from debris, contaminations, adulterations or vermin infestation. The macroscopic appearance and taste of spurious or adulterated spices may

simulate those which are genuine. When in doubt regarding spices used for Army meats, samples should be sent to a Medical Department Laboratory for examination, in accordance with Army Regulations. Frequent inspections of spices and their storage should be made in establishments granted inspection.

(f) Wood Smoke. Authorized wood smoke is produced by burning desirable wood or wood sawdust as hickory, apple, bass wood, birch, cedar, cypress, maple, whitewood and others. Corn cobs may also be used. Wood or sawdust containing resin or pitch as Southern pine is unfit for smoking purposes. (See "3. Commercial Smoking.")

(g) Water. (See "Manufacture of Ice," Chapter VIII.)

(2) Unauthorized. Non-condimental and unauthorized agents as boric acid, borax, sulphurous acid, salicylic acid, sulphite of soda, calcium bisulphite, wood vinegar, solution of formaldehyde, glycerin, crude pyroligneous acid (liquid smoke) and others should not be used to preserve meats for the Army.

Boric acid and borax may be used commercially in packing cured meats for export. These agents preserve the natural meat color and inhibit bacterial growth.

Sodium sulphite is not a meat preservative and does not prevent decomposition changes. When placed on the surface (as display meats) or used in hashed meats (as fresh sausage or hamburger) sodium sulphite may maintain a red color in the meats, preventing their becoming gray, even when such meats are decomposing and dangerous to human health.

2. Curing or Other Preparation. a. General. The first consideration in curing should be the sanitation of compartments, equipment, methods and personnel; the source and purity of products and ingredients; the systematic handling of products, their preparation for curing, grading, accurate preparation of curing mixtures and solutions, uniform methods, proper length of cure and the handling and packing of the finished product.

b. Pork. Pork cuts are ideal for curing because of their high fat content. About eight-tenths of all pork products are cured by dry preservation, pickling and combination or special cures. All green (chilled) pork cuts should be placed into cure within twenty-four hours after being cut.

(1) Dry Preserved Pork. (a) Dry Salt Pork. Domestic and English or export pork cuts may be preserved by the "dry salt" method of curing wherein the dry curing agents as salt, or dry salt mixture

containing salt, saltpetre and sugar, are applied directly to the surface of the meat which is then piled in a chill room (curing cellar) to cure.

Domestic Dry Salt Pork. Pork cuts cured by the dry salt method for domestic consumption include rib bellies, clear bellies, extra short clears, rib backs, short clear backs, short fat backs, long fat backs, regular plates, clear plates, jowl butts, spareribs, New Orleans shoulders, three rib shoulders, a small percentage of hams, short ribs and regular short ribs.

Handling Pork Cuts to be Cured. Pork cuts should be thoroughly chilled and handled as quickly as possible into cure. The temperature in the center of thick cuts should not be more than 36°F. When cuts have not been chilled sufficiently for cure, they may be spread on clean racks in the curing cellar until the desired temperature is attained. Frozen meats do not "take" the cure and must be defrosted properly before being placed into cure, otherwise they are very likely to spoil. Cuts may be trimmed just prior to being placed into cure with all tag ends of tissues removed. The crotch fat of hams should be removed.

Placing into Cure. *Pumping.* Nearly all dry salt, pork cuts with the exception of thin, fat, boneless cuts, are injected or "pumped" with concentrated brine at the time they are placed into cure or "put down." This is done to hasten the curing operation; to prevent sourness in thick cuts having a high percentage of bone and to facilitate thorough curing of coarse, heavy, rough, thick cuts and those (as the shanks of hams) which are well covered with thick, non-absorbing skin where diffusion of curing ingredients would be slow. The solution injected or "pumping pickle," usually is a saturated or 100° plain pickle (salt and water) to which may be added, 2 to $2\frac{1}{2}$ per cent of saltpetre. This solution is introduced into the meat through a hollow, perforated needle-nozzle connected by means of a flexible, rubber hose to a ratchet pump. The ratchet pump is adjustable so that any desired amount, usually 3 ounces, of pickle can be delivered with each downward stroke of the pump handle. The needle is inserted into the meat (a "stitch") and the pumping pickle is forced into the meat by means of the pump. Usually a certain number of "strokes" are specified for each "stitch." Pumping should be well distributed.

The amount of pickle injected varies according to the kind, weight and quality of the pork cuts, the thickness of the lean meat and the amount of bone. Rough ribs, shoulders, picnics and hams are pumped with many stitches and strokes while light clear bacon bellies, clear plates and fat backs scarcely at all.

In some houses a gravity pressure line connected with a brine tank on an upper floor is used instead of a ratchet pump. When this system is employed, a regulating valve is placed between the hose and the needle.

The needle used for pumping meat, the pumping pickle and all apparatus should be clean and sanitary. The needle should be tested from time to time to insure that the perforations are not clogged.

Salting. Fine, dry salt as vacuum pan salt or a dry salt mixture may be used. In preparing a dry curing mixture it is important that the correct amounts of the ingredients are weighed out and properly mixed. This mixing may be accomplished in a large box by means of shovels or in a mechanical mixer. The pork cuts may be weighed out into 2-pound averages to determine the length of time to be cured, and then graded for quality. A pork cut is placed skin side down on a clean, mixing table containing a quantity of salt or dry salt mixture. About 6 to 7 per cent by weight of the curing agent is rubbed over the edges, and sprinkled on the flesh side of the meat. Before salting, meats may be sprayed with or immersed in brine to moisten the surface of the meat to facilitate more of the dry curing agents adhering to the surface of the meat and to promote their solution. A moving salting table may be used.

Piling. After the pork cuts are properly covered with the curing ingredients they are piled, skin side down on clean floors, which have been sprinkled with a thin layer of second salt, or on floor racks, as closely as possible to prevent the escape of moisture and to exclude air. Where floor racks are used the loss of moisture through drainage is increased about 1 per cent. Meats, according to kind are piled in symmetrical piles of varying heights. Meats should not be piled against an outside wall, but a space should be allowed to aid cold air circulation. Hams may be piled 4 feet high, while cuts which do not pack closely, as ribs, may be piled 8 to 10 feet high. The higher the pile the greater will be the pressure on the lowest layers of meat consequently a greater loss of moisture and a lessened opportunity to cure. Often one lot will contain 25,000 to 50,000 pounds of meat. In piling hams, the shank end should be lower than the body to aid the diffusion of the cure by gravity into the shank.

Curing. *Sanitation.* Clean splash boards 3 feet high should be used around the base of each pile to prevent splashing of meats when squeegeeing wet floors and as a protection against passing trucks. When splash boards are not provided, clean second-salt may be banked

around the base of each pile. Floors should have good drainage, be kept clean and free from pools of brine and in a good state of repair to prevent rat infestation. Water from ceilings and refrigerating coils should not be permitted to drip on meats, and utensils or other materials should not be stored on meats in cure.

Curing Temperatures. Curing cellars should be maintained between 34 and 38°F. as lower temperatures retard curing and higher temperatures favor bacterial growth which may lower the keeping qualities of products in cure.

Absorption of Curing Agents. Salt extracts moisture from the meat which rapidly dissolves the dry curing ingredients, forming a brine which may be noticed within a few hours after piling. In twenty-four hours brine pools may be discerned in depressions in pieces on top of the pile. The brine penetrates the meat through osmosis, capillary attraction, diffusion and gravity. By the end of seven days most of this surface brine has been absorbed by the meat or drained off.

Overhauling. Meats should be watched carefully all the way through cure, and overhauled, resalted and repiled several times at regular intervals to change the pressure on underlying meats, to insure a uniform penetration of the cure and to continually assure a steady, progressive, curing process. At overhauling, the meats are removed from the pile where put down; resalted, dry or moistened, with or without pumping and again laid down as before. Overhauling is usually done every twenty days. Fat cuts as fat backs may go longer. The first overhauling may take place in six to eight days, the second in eighteen to twenty days, the third in thirty-five to forty days and then every forty days thereafter until finally shipped. At each overhauling sufficient fine salt or dry salt mixture is used to bring the total amount of curing ingredients up to about 6 or 7 per cent. At each successive overhauling less of the curing agents are required as less solution and absorption takes place as curing progresses.

To reduce the length of time in cure by about five to ten days, force curing may be accomplished by more frequent overhauling, as on the third, twelfth and twenty-first days, and by repumping well with additional pickle at each overhauling.

When the cure has penetrated throughout large pieces and the fat is not pinkish in hue but gray, the meat is cured and can be shipped or smoked without much danger of spoilage.

Length of Time in Cure. The curing periods for the different classes, kinds and grades of pork cuts vary considerably with their weight,

size, the amount of pumping, amount of curing agents applied, methods of overhauling, curing cellar temperatures and other factors. Meats which are frozen, properly thawed and placed into cure are said to cure in two-thirds of the regular time and to be more tender. The curing process may be shortened by heavy pumping at overhaulings. Thick pork cuts as hams and shoulders with a large amount of long bones, irregular in shape or with large epiphyses, require longer curing periods than do thin bellies, fat backs or other similar cuts. Meat cures more rapidly at 38 than at 34°F. Bellies may require two days per pound weight or twenty-eight to forty days to cure, ribs may require four days per pound weight or fifty to sixty or more days to cure. Shoulders may be cured in forty days and clear backs in twenty to thirty-five days.

Overcured Meats. When salt is used in excess or the curing operation prolonged, overcuring may result. The thin edges or parts of cuts are frequently overcured. Such meats may have an extreme salty flavor and salt crystallizes out on the surface. Saltpetre used in excess will shrivel the meat which gains a burned appearance.

Shrinkage. While there is a slight gain in weight in cure from salt penetration and pumping pickle, there is an excess of moisture extracted from pork cuts which drains off and is a distinct loss in weight. This loss or shrinkage is greatest the first fourteen days but continues slowly throughout the curing operation. The shrinkage from green (chilled) to cured condition varies with the kind of pork cut, relative amounts of bone, fat and lean meat, weight and size of the pieces, amount of pumping, the manner of piling, length of curing period and curing temperatures. Cuts containing practically all fat as jowls, fat backs and clear plates will show a gain in cure from 1 per cent up to $2\frac{1}{2}$ per cent while cuts containing considerable lean as bellies, ribs and short clears will shrink from 0 to 3 per cent and dry salt shoulders will shrink from 3 to 5 per cent. During curing there may be a loss of meat salts, bases, nitrogenous and other nutritive substances.

Removing from Cure. When removed from cure for domestic shipment, dry salt meats are "tossed" or thrown on a slatted table ("tosser") with the flesh side down, to remove excess salt which falls through the slats. If to be re-used as "second salt," the tosser is placed over a clean truck arranged to receive the salt as it falls. Second salt should be handled and stored under clean, sanitary conditions. It may be sprinkled on floors upon which dry salt meats are laid down, to bank around and to cover piles of meats in cure and for the manufacture of pickle solutions.

Dry salt meats may be converted into other cuts. For example, dry salt ribs may be divided into rib backs and rib bellies and these cleared resulting in clear backs, clear bellies, dry salt spareribs, back bones and trimmings.

When domestic dry salt meats are smoked they are known as, "Bacon Meats." (See "Smoking.")

English Dry Salt Pork. English or export pork cuts include Wicklow and Stretford sides; Cumberland, Birmingham and Dublin Middles; regular and extra long clears; export clear backs, export short fat backs, Antwerp backs and Lexington loins; English bellies; 3 rib shoulders; and long cut, York, Manchester, Stafford, French, Bayonne, Dutch and Hamburg hams.

These cuts are made from bacon hogs and usually are cured by the dry salt method using a milder cure than for domestic dry salt meats. At "laying down" the cuts may be pumped to about 4 or 5 per cent; immersed in brine or sprayed, then salted with fine English salt, 4½ to 6 pounds per 100 pounds of meat to which is added about 4 ounces of saltpetre. Generally 3 days in cure are allowed per pound weight, however, English meats may be transported before thoroughly cured, as curing progresses during shipment. Combination curing methods also may be employed. Upon their arrival at foreign ports, English or export meats may be further processed by being divided into smaller cuts, dried or subjected to a light smoke.

(b) Dry Cured Pork. Certain pork cuts, trimmings for sausage and offal parts may be preserved by the "dry cure" method wherein, after the dry curing agents have been applied directly to the meat, the products are packed into water-tight boxes or tierces or spread on trays to cure.

Pork Cuts. Mild sugar cured, fancy, or special breakfast bacon and canning breakfast bacon may be dry cured in tight boxes or trucks.

Bellies. The best quality of the finest selected, fresh chilled or frozen, clear bellies, square trimmed and seedless from 3 to 13 pounds, are used. When the supply exceeds the demand, trimmed or untrimmed bellies may be piled and pressed into blocks of several layers or packed in tight, cardboard boxes; spaced in a sharp freezer; frozen; then repiled tightly in a storage freezer to hold. The piles of bellies in the freezer are covered with paper or tarpaulins to prevent contact with air as much as possible, otherwise the bellies may dry out, become discolored or rancid. When removed from the storage freezer for curing they should be separated into individual pieces while frozen and spaced on

thoroughly clean and sanitary racks at 50 to 60°F. to thaw out. As soon as defrosted, bellies should be placed promptly into cure and not allowed to become slimy or sticky.

Curing Agents. To each hundred pounds of bellies 3 per cent of butter salt or other, clean, fine, dry salt; $2\frac{1}{2}$ per cent of refined or plantation, clarified sugar and coarse, brown sugar; 0.4 per cent of refined saltpetre and a varying quantity of red, black or white pepper, bay leaves or other spices may be thoroughly mixed in a churn or other mechanical mixer to insure uniform proportions, then placed on a salting table.

Curing Containers. For canning bellies, galvanized iron trucks holding 850 to 1500 pounds of meat may be used. For fancy bellies, tight, wooden boxes or wooden boxes of various sizes lined inside with galvanized iron may be used. Each box has a heavy, hinged lid with a hasp and a removable cover rack, or, a heavy removable cover or "follower" which fits inside the edges of the box. These boxes are tight to prevent meat in cure from coming in contact with the air, resulting in loss of moisture and the development of strong flavors which may be brought out when pieces are smoked. One packer uses a curing box 32 x 26 x 20 inches inside dimensions. One authority states,

> The latest style in curing boxes is made of $\frac{7}{8}$-inch common pine wood; inside measurements 37 inches in length, 23 inches in width, 21 inches in depth, with a galvanized iron lining, which is framed around the top of the box and nailed. The frame on the outside of box on the ends is 4 inches in width. The cover on the outside has an extra strap 5 inches in width on each end. On the inside we have twelve $1\frac{1}{2}$ inch cleats, made out of clear pine wood, $1\frac{1}{2}$ inches apart. The cover is fastened to the box with two 12-inch strap hinges and two 10-inch hasps and staples.

These curing boxes, racks and covers should be steam sterilized fifteen minutes with dry steam, and the boxes lined on the bottom and sides with clean oiled or wax paper before being filled with bellies.

Laying Down. A definite amount of curing mixture is weighed out for a definite quantity of bellies to be cured in a box. The curing mixture is rubbed on the edges of each belly and the face side lightly covered. The bellies are then placed flat, skin down, in orderly arrangement in the curing box, in layers. Each layer is tamped tightly with a heavy block of wood so that vacant spaces or interstices do not remain. The more solidly packed, the better and more uniform will be the cure. Each layer of bellies is lightly sprinkled with curing mixture well distributed. Several layers are packed into the box until it is quite

full. The top layer is packed skin side up, a layer of oil paper is put on, a rack inserted and the hinged lid clamped down; or the follower is placed under continuous pressure by weights, hydraulic or screw jacks or by wedging with timbers to a superstructure or ceiling. Pickle results from the moisture from the meat and curing agents, and fills all interstices between the bellies and the space between the top layer of meat and the cover.

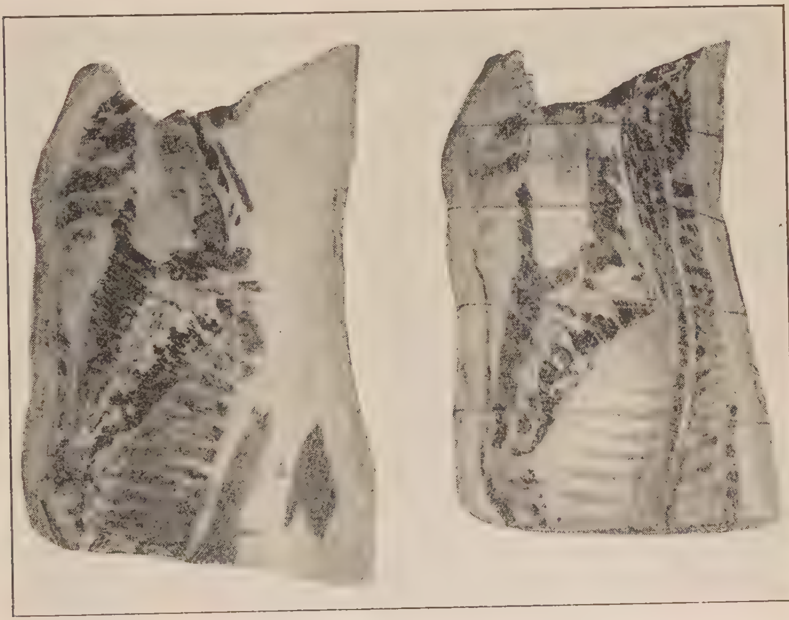
Curing. Three to four days is cure are allowed per pound weight of pieces. Defrosted bellies may cure in fifteen to twenty-five days while chilled bellies in twenty to thirty days at 36 to 38°F. One packer cured 3–5 pound averages fifteen days, 5–7—twenty days, 7–9—twenty-two days, 9-11—twenty-five days and 11–13—twenty-eight days. The bellies remain in curing boxes without overhauling until cured. There is no gain in cure. A small loss in weight from 0 to 1 per cent may result.

If pickle gets low during the curing periods the box should be filled up with sound pickle from boxes from which cured bellies have just been removed, or a sweet ham pickle to which is added 10 ounces of white sugar per gallon, may be used. When boxes are leaky, permitting an evaporation of pickle, a strong flavor due to action of air may result. As a rule this flavor cannot be detected until after smoking.

Removing From Cure. If not smoked within five days after completion of curing, bellies may be stored at 14°F. or lower in the curing boxes as originally packed. (See "Smoking.")

Pork Trimmings. Pork trimmings, cheek and head meat, boneless butts, and other sausage meat in pieces or ground may be cured on trays, in boxes or tierces by the dry or curene cure. Products to be cured should be strictly fresh, clean and not frozen. All apparatus, tables, containers, implements and handling should be clean and sanitary. The curing materials, which may consist of salt $4\frac{1}{2}$ pounds, sugar 1 pound and saltpetre 3 ounces, per hundred pounds of meat, are mixed with or incorporated in the pieces or hashed meat by means of shovels or a mechanical mixer. The mixer may be on the order of a barrel butter-churn with a 400 pound capacity. The meat and curing ingredients are placed into the mixer which is revolved about ten to twenty minutes when the product is dumped into a flat truck or other container placed underneath the churn. One and one-half gallons of 70° sweet ham pickle may be added to 400 pounds of meat to be churned. The churn is a time and labor saver and the curing mixture is forced into the meat, making the cure more thorough.

After mixing, the products are solidly packed into tight boxes or tierces to exclude air. The tierces are headed up using cheese cloth or oil paper between the meat and tierce head. The containers are placed into a chill room at 36 to 38°F. and cured from ten to thirty days according to size of pieces or about five days if hashed. To hold after curing, the containers may be placed into a freezer at 10 to 12°F.



(Permission United States Bureau of Agricultural Economics)

D. S. extra short clear D. S. short rib (lined for mess pork)

FIG. 48. PORK CUTS

Pork Offal. (See "Pork Offal," Chapter VIII.) Tongues for jellied tongues, are washed, then scalded ten minutes in water at 130 to 145°F. or until the skin (mucosa) is loosened, care being exercised to avoid cooking the tongues; then chilled with cold water, skins removed, chilled in the cooler, mixed with curene cure in a mechanical mixer and packed tight in tierces to exclude air and cured twenty-three to twenty-five days.

(2) Pickled Pork. (a) Plain or Salt Pickle Pork. Plain or salt pickle meats are pieces from the sides of fat hogs, including standard mess

pork, back, belly, and shoulder pork, and spareribs (see Chapter VIII, "Classes of Pork Cuts") cured in plain brine with or without saltpetre and barreled for shipment. Hams are not made into barreled pork. Offal parts as lips, snouts and ears also are included.

Plain Pickle. Plain pickle or brine is a solution of NaCl and water. A gallon of pure water at sea level at 60°F. weighs 8.34 pounds and will dissolve 3.03 pounds of NaCl resulting in more than 1 gallon of pickle. At 60°F. it requires about $2\frac{2}{3}$ pounds of salt per gallon of water to make a saturated solution or 100° pickle. In measuring the density or specific gravity of pickles a salinometer or salometer resembling a hydrometer is used. This instrument has a stem which is graduated in degrees from 0 to 100. When placed into water at 60°F. it registers 0° and when placed into a saturated salt solution 100°.

When a brine is to be tested, it is thoroughly stirred, then a long receptacle of sufficient depth to accomodate a salometer, is filled with the pickle. The salometer is placed into the pickle at 60°F., allowed to settle for a minute or more, then the reading is observed.

In the manufacture of plain pickle a clean vat or salt leaching bed is filled with any ordinary grade of clean, new salt, as No. 1 rock salt; then clear, pure water is run into the vat. The saturated or 100° brine which results is drawn off into settling vats where it is settled overnight, clarified through sponge filters, sterilized by heating at 200°F., then run into holding or formulating vats for standardization or mixing. No off grade or contaminated salt should be used for making pickles.

Strength of Plain Pickle Solutions
(*After Edelmann*)

Amount of salt	Salinometer reading	Specific gravity (60°F.)	Freezing point (F.)
pounds	*degrees*		
0.00	0	1.000	32.0
0.50	20	1.037	25.4
0.75	30		22.0
1.00	40	1.073	18.6
1.25	50		15.0
1.50	60	1.115	12.2
1.75	70		9.0
2.00	80	1.150	6.86
2.25	90		3.0
2.50	100	1.191	1.00

BRINE

DEGREES ON SALOMETER	PER CENT SALT, BY WEIGHT PER GALLON	POUNDS SALT PER GALLON	WEIGHT PER GALLON (39°)
4	1	0.084	8.40
8	2	0.169	8.46
12	3	0.256	8.53
16	4	0.344	8.59
20	5	0.433	8.65
24	6	0.523	8.72
28	7	0.617	8.78
32	8	0.708	8.85
36	9	0.802	8.91
40	10	0.897	8.97
48	12	1.092	9.10
60	15	1.389	9.26
80	20	1.928	9.64
96	24	2.376	9.90
100	25	2.488	9.97
	26	2.616	10.04

Containers. Pork barrels are made from well seasoned white ash; birch; red, white or burr oak; or other hardwood. They are iron bound and may have an inside coating of refined paraffine, wax or other approved substance to fill up the pores in the wood and thus prevent soakage and leakage. A barrel of standard size has a capacity sufficient to contain 200 to 204 pounds of cured meat, about eleven gallons of pickle and 40 pounds of capping salt, or 350 pounds gross. Half barrels may contain 100 pounds net or 190 pounds gross and quarter barrels 50 pounds net or 105 pounds gross. Barreled meat is quoted by the barrel and not by the pound. Second hand barrels should not be used.

Pork Cuts. About 180 to 193 pounds of green (chilled) pork is packed into a barrel. Heavy pieces and those with bones as shoulder, rump and loin pork, may be pumped. Saltpetre is sometimes used, except for clear pork. Six ounces of dry Chili saltpetre or 8 ounces of India saltpetre per barrel may be rubbed on the meat. Thirty pounds of capping salt (a clear rock salt with pieces about ½ inch in thickness) for fat pork and 40 pounds for lean pork per barrel may be used, ¼ on the bottom, ¼ in the middle and ½ at the top of each barrel. The barrel may be filled up with 80° to 100° plain pickle, using about 5 to 6½ gallons per hundred pounds of meat. If saltpetre has not been added to the meat, and is desired, it may be added in solution with the

pickle, using 0.8 ounce of Chili or 1 ounce of India saltpetre per gallon. Instead of brine being used, about 15 pounds of fine salt may be rubbed on the meat at time of packing and the barrel filled with pure, cold water. Parchment paper squares may be used on the bottom and at the top of each barrel. Barrels are headed up, and placed into a cooler temperature to cure. They may be overhauled on the fifth, fifteenth and thirtieth days by rolling each barrel on its bilge for several hundred feet, thus loosening up pieces of meat in close contact and circulating the pickle. Leakers should be inspected, re-tightened or coopered and re-brined at each overhauling or whenever discovered. Barreled pork gains in cure from about 7½ to 11 per cent by absorbing pickle and curing ingredients and increases in weight to about 200 to 204 pounds. It may be cured in twenty to thirty days. Plain pickle meat is sold in the same barrel in which cured, or it may be cured in vats and repacked in barrels, half or quarter barrels. At time of shipment barreled pork may be re-brined with 100° plain pickle. Some clear pork is leached in 80° plain pickle, in vats, ten to thirty days, then packed in barrels using new pickle. Barreled pork should be kept in cool storage, and covered with brine at all times. Leakers should be carefully coopered and re-brined with 100° brine. If kept ninety days it may be placed into a freezer to "stay" or stop the cure. Barreled pork should be uniform in color and condition at time of shipment.

Offal. Pork snouts, lips, cheek meat, hearts, heads, hocks, skins, ears and tails which have been properly chilled on screens at 32 to 34°F. overnight, may be cured in vats, tierces, barrels or other containers using 80 to 100° plain pickle containing saltpetre. Such meats may be cured in twenty-five to thirty days with a gain of 10 to 30 per cent. Skins, ears and tails may be cured in ten days. These meats may be used as sausage meats or shipped. At time of shipment, barrels may be re-brined with 100° brine, and 30 to 50 pounds of fine salt added to each barrel. Cured meats are sometimes re-packed for shipment in containers smaller than barrels. Tierces which have contained lard should not be used as curing containers.

(b) Sweet Pickle Pork. Sweet pickle or sugar-cured pork cuts include regular and skinned hams; picnic, skinned and New York shoulders, clear and light rib bellies, bacon squares, boneless butts and spareribs, which are cured in vats or tierces in a compound or sweet pickle solution containing water, salt, saltpetre and sugar. After curing, the bulk of these meats is smoked, some are used in boiled meats while a negligible percentage is sold to the trade. Offal parts as tongues and tails are also included.

Pickles. *Compound or Sweet Pickle.* In making a new, compound or sweet pickle solution for curing, usually 3 salometer degrees are allowed for the saltpetre and sugar added to a plain pickle. In a formulating vat, 100° pickle usually is reduced to 70 to 75°. To each hundred gallons of the reduced pickle usually there are added 4 pounds of Chili saltpetre or $4\frac{3}{4}$ pounds of India saltpetre and 14 to 27 pounds of brown sugar. The lower grades of meat are cured with a smaller amount of sugar. If granulated sugar is used about 87 per cent of the above amounts for brown sugar is required. If syrup or molasses is used the amount added to a compound pickle is based on their sugar content (see "1. General"). The saltpetre and sugar should be thoroughly dissolved in a separate tank before being added to the brine. The finished pickle is standardized to about 75 to 80 salometer degrees. It should be at a temperature of 36 to 38°F. when used.

Second Pickle. Sweet pickle remaining in tierces or vats after curing, contains many microörganisms, albuminous and other foreign matters and if re-utilized may cause deterioration and souring of meats cured in it unless it is properly strained, pasteurized, cooled, settled, filtered and standardized. After straining, it is vat pasteurized under agitation one hour at 190 to 200°F., the coagulated albumen which forms is skimmed off and the pickle is quickly cooled to 36 to 38°F., settled and may be forced through a filter press.

During the pickling operation, meat in cure absorbs some of the curing agents and reduces the pickle in strength until it is about 50 to 70° on the salometer. This pickle is analyzed and the required amount of curing agents and 100° brine added to bring the pickle up to desired strength. This pickle is rich in nitrites and may be used in curing lower grades of meats as "second" or "used" pickle, or used in the manufacture of "second" pumping pickle. (Also see "Corned Beef—Short Cure.")

Pumping Pickle. This may be a "new" or a "second" pumping pickle.

New pumping pickle for sweet pickle meats may contain water, salt and saltpetre. Sometimes brown or granulated sugar may be included. To 100 gallons of 85 to 100° brine there may be added 25 to 35 pounds of sodium nitrate, or 30 to 40 or more pounds of potassium nitrate, and 25 pounds of granulated sugar. The solution which results, is pasteurized and cooled. It should be free from all materials in suspension and from sediment. When used it should be from 36 to 38°F.

Second pickle which has been properly treated as described above may be standardized and used as "second" pumping pickle.

Containers. Sweet pickle meats may be cured in open concrete or wooden vats or in closed tierces. Concrete curing vats, with a smooth, oil-finish inside and with proper drainage are very easily kept clean. A standard wooden curing vat has a capacity of about 1,450 pounds of meat which requires about 75 gallons of pickle solution to cure. Tierces are made of the same kinds of wood and may be coated inside as discussed for pork barrels. New oak tierces unless properly coated inside, because of their tannin content, may discolor meat cured therein. Ash tierces have not this property and are more desirable. Usually 285 pounds of meat to be cured and 14 to 15 gallons of pickle are packed in a tierce. Tierces which have contained lard should never be used for curing purposes. It is almost impossible to remove the lard contained in the pores of the wood even by thorough steaming. This lard becomes rancid and exerts a detrimental effect on meats in cure. All curing containers should be washed and steamed thoroughly inside and if possible, subjected to the sun's rays each time before being packed.

Pork Cuts. Handling Cuts to be Cured. In general this is the same as described under "Dry Preserved Meats." Pork cuts are graded according to weight averages to insure uniform curing. Meats improperly chilled may become pickle soaked and mushy in cure.

Placing into Cure. *Pumping.* As a safeguard against deteriorations and to accelerate curing, hams, shoulders, picnic shoulders and practically all bellies, especially rib bellies are pumped when placed into cure. Hams and shoulders should have the needle inserted so that the pickle is delivered in the shank and in the region of joints. About 3 ounces are discharged at each stroke. Hams 12/14 pound averages may be pumped 2 strokes, 14/16—3 strokes and 16/ up—4 strokes; shoulders 10/12—3 strokes, 12/14—4 strokes, 16/22—6 strokes and 22/37—7 strokes; and picnic shoulders 5/6—2 strokes, 6/8—3 strokes and 8/12—4 strokes.

Vats. Meats instead of being placed into vats in a uniform manner may be tossed in regardless of orderly arrangement. The filling of vats should be expedited. When full, a rack or "heading" is inserted in the vat over the top of the meat and secured in place by a cleat, to keep the meats completely submerged during cure. The vats then should be promptly filled with curing pickle at the desired strength. Usually it requires 70 to 75 gallons of pickle to 1450 pounds of meat.

All pickle used should be properly prepared, clean and at 36 to 38°F. at time of using.

Tierces. A definite weight of meat, about 285 pounds is packed in a tierce. The tierce is headed up tight and the desired strength of pickle introduced through the bung until the tierce is full. Five and one-half to $5\frac{3}{4}$ gallons of pickle may be used for a tierce of hams or shoulders, 6 to $6\frac{1}{2}$ for bellies and $6\frac{1}{2}$ to 7 for boneless butts. Instead of pickle being used, the meat may be sprinkled or rubbed with a dry salt mixture at time of packing and the tierce filled up with pure, cold water.

Curing. *Sanitation.* The curing cellar, containers, products and pickles should be maintained in a sanitary condition. Temperatures should be regular and maintained between 36 and 38°F. Rooms should be free from off odors, dust and vermin, they should not be excessively damp or wet, and meats in cure should not be subject to contamination from drippings.

The pickle should be frequently tested for soundness, strength and amount. It should not be sour, contaminated or ropy. Ropy pickle is sticky and "stringy" in character with a foetid odor when heated. It may be found in old, unclean, contaminated pickles; when unclean containers, slimy meats or impure sugar are used; or where warm temperatures exist. It is due to microörganisms, and may cause meats to spoil unless promptly dumped, the meats washed and then put down in a clean container using good, fresh pickle. The containers of ropy pickle should be scrubbed with hot water, steamed thoroughly and if possible, sunned one day before again being used. The strength of the pickle may be tested from time to time during curing with a salometer, or analyzed, and when reduced in strength it should be re-standardized. When a vat is found short of pickle, it should be promptly refilled with new pickle. Meat hooks should be sanitary and when used, care should be exercised to prevent damage to meats. Pork cuts should be picked up by the skin or places where tears or punctures of the lean meat or face will not occur and which may result in discolored areas, excessive absorption of pickle or sourness.

Overhauling. Pieces of meat in cure are in close contact with each other and with the sides of the container. There is very little if any pickle circulation and the pickle nearest the meat in cure may be reduced in strength somewhat through absorption. The position of meat in cure should be changed and the pickle circulated at regular

intervals by overhauling to make thorough, uniform pickling certain and to promote progressive curing. At overhauling, meats in vats may be thrown into an adjacent, clean, empty vat and then the pickle transferred by siphoning or with a bucket. Tierces of meat in piles are overhauled by "breaking down" a pile, rolling each tierce about 100 feet, then repiling. Any leaky tierces should be re-coopered, inspected and refilled with pickle of the desired strength. Overhauling of larger cuts as hams and shoulders is accomplished about the fifth, fifteenth and thirtieth days and every thirty days thereafter. Pieces as bellies or other small meats which cure under thirty days may be overhauled on the third, tenth and twentieth days.

At the third overhauling of hams and shoulders in vats, a 5 to 10 per cent trier inspection may be given, and if necessary a 100 per cent examination; record being kept of the kind of meat, number of pieces in the lot, number of pieces inspected, number of pieces rejected and reason for the same. Meats are sometimes pumped at the first overhauling.

Length of Time in Cure. Generally, hams require fifty to one hundred days to cure, picnic shoulders thirty-five to forty-five days, and bellies twenty to thirty days depending on thickness and weight. Hams and shoulders are usually cured four and one-half to five days per pound weight and bellies three and one-half days.

CURING PERIODS

PRODUCTS	AVERAGES	TIME REQUIRED TO CURE
	pounds	*days*
Hams	18/23	75
Hams	15/18	65
Hams	10/15	55
Hams	Under 10	50
New York Shoulders	10/12	45
Light Shoulders		35
Picnic Shoulders	11/up	55
Picnic Shoulders	9/11	40
Bellies	Heavy	30
Bellies	Light	25
Bellies	Under 10	20
Spareribs		25

In curing pork cuts which have been frozen and subsequently thawed, the time required to cure is reduced about 30 per cent.

Cured meats should not be held in cure more than five days after curing has been completed.

Gain. All pork cuts show an average gain in sweet pickle cure from 6 to 12 per cent. Sweet pickle hams and shoulders will show an actual gain of 6 to 9 per cent and sweet pickle bellies 7 to 12 per cent. In weighing meats coming directly out of pickle a drainage allowance is made as follows: hams 4 per cent, picnic shoulders and bellies 5 per cent. If drained twenty-four hours a 2 per cent allowance may be made.

Electric Curing. Electric curing of pork is not desirable. This curing process consists of passing an electric current through meats in pickle vats, accompanied by mechanical circulation of the pickling solution thereby reducing the curing period about 50 per cent, but with the release of chlorine through electrolysis of NaCl and the resultant contamination of compartments.

Removing from Cure. The preparation of cured meats for smoking and their handling for boiling purposes is discussed in succeeding sections. Pickled hams and shoulders for export may be removed from cure near the termination of the curing period and banked in dry salt seven to ten days for the removal of excess moisture. Sweet pickle pork cuts, if in first class condition, sound and free from slime and mould when fully cured, may be removed to a cold storage room and piled on racks to drain. They may be held and packed at 36 to 38°F. fifteen days; at 26 to 28°F. thirty days; and under 20°F. fifty days. If to be held up to six months time, cured meats may be "back packed" by being packed in tight tierces and covered with 25 to 40° new or second pickle, leaving a little air space in each tierce to prevent bursting when frozen, then stored in the freezer at 0 to 12°F., to stop the cure. Meats will continue to cure at 15°F.

Where there is a surplus of pork cuts for cure it is more desirable to freeze the green cuts at 10 to 15° below F. seventy-two hours and then store them at 0 to 10°F. until needed, than it is to back pack.

Offal. Pork Tongues. For domestic or export use, pork tongues are handled as quickly as possible after their removal from heads. They are washed free from hair or other contamination, thoroughly chilled twelve to thirty minutes in cold water, hung in the chill room at 32 to 36°F. for twelve to twenty-four hours, trimmed after chilling, leached in open headed tierces in 70 to 80° brine twenty-four hours and repacked in barrels or tierces lined with muslin bags. Tongues are packed in regular order with butts out, points toward the

center and faces (dorsal surfaces) down except the last 6 layers may have the faces up. About 15 pounds of fine salt are sprinkled between the layers of tongues. The curing packages are filled with 70 to 80° sweet pickle, using about 7 to 8 gallons to 100 pounds of tongues. Curing is done at 36 to 38°F. and overhauling on the fifth and fifteenth days. Tongues will be cured in twenty to thirty days depending on size. In cure they shrink one-half to 2 per cent. (See Chapter VIII, "Pork-Offal.")

Tails. Tails may be packed 280 pounds to a tierce, scattering 60 pounds of capping salt between the layers, then the tierce filled with sweet second pickle. Barrels, half barrels and other packages may be packed similar to tierces. Tails may be pickled, 1200 pounds in vats, and repacked into tierces for shipment. For hot climates tails may be repacked using 100° plain pickle and 50 pounds of capping salt per tierce.

(3) Combination and Special Cures (Pork). These include pork products customarily eaten without cooking, sour pickled meats and others.

(a) Pork Customarily Eaten Without Cooking. These products include Westphalia hams, Italian hams, boneless butts for capacola or coppa; boneless shoulder and ham butts for "Cottage" ham and boneless ham; certain loin rolls, pork trimmings for summer sausage; and beef and pork mixtures which are not cooked. (See Chapter VIII, "Pork Trimmings"—also Chapter XII).

Westphalia Hams. One method of curing and preparing these hams is as follows: hams of 16 to 20 pounds averages are selected from prime hogs; dry salt cured three days per pound, using salt 4 pounds, sugar 3 pounds and nitrate of soda 4 ounces; overhauled on the tenth, twentieth and thirtieth days, adding the same proportion of curing mixtures each time; washed with water at 80°F., dried; strung; smoked ninety-six hours at 120°F. and placed in a drying room at 45 to 50°F. for ninety to one hundred days.

Italian Hams. These are made from thin, long-cut hams weighing 12 to 15 pounds average, and cured similar to Westphalia hams. At the second overhauling they are placed in cure under heavy pressure to flatten them out. After curing, they are washed off and heavily coated with ground, black pepper. A molasses coating may be used to cause more pepper to adhere. Usually Italian hams are not smoked, but may be dried in large rooms as summer sausage rooms, or placed into a smoke house and given dry heat for ten days at 90°F., then placed

into a dry room sixty to one hundred days at 45 to 50°F. They are eaten raw. Another method of manufacture is as follows: Hams are frozen thirty days at not higher than 5°F., defrosted, sweet pickle cured twenty-five to thirty days, drained, covered with salt, pressed ten days, washed, heated at 130°F. twenty-four hours in a smoke house and hung in a drying room three weeks.

(b) Sour Pickled Meats (Pork). *Pigs' Feet.* Usually only the fore feet are pickled, the hind feet being used principally for lard. On the killing floor the toes and dewclaws should be removed and feet thoroughly shaved before chilling. The fore feet may be removed on the cutting floor, singed, washed in a revolving washing machine, and trimmed. The interdigital tissues including glands should be removed with a knife as well as all remaining scurf, hair, bruises and discolored areas on the soles of the feet. After the feet are entirely clean they are spread on racks overnight at 32 to 36°F., then packed in vats or tierces, covered with plain pickle, about 80° and containing about $4\frac{1}{2}$ ounces of saltpetre per hundred pounds of feet. After curing, which takes about twenty days, the feet are placed into a clean, sanitary cooking box or vat, covered with cold water, steam turned on and a cooking temperature of 180°F. maintained for three to four hours. Feet to be boned are cooked longer to facilitate this operation. After cooking, the feet are chilled in cold water. They may be used whole or split lengthwise and washed, then packed 250 pounds in a tierce or 800 to 1200 pounds in a vat and covered with 45 grain vinegar. In twenty days they may be repacked for shipment in barrels or smaller packages, using about $22\frac{1}{2}$ grain vinegar and allspice, coriander seeds, black pepper, bay leaves or other spices. Boneless pig feet may be pickled, canned or used in souse.

(c) Miscellaneous. Many varied curing combinations are employed. Boiled and cooked meats, boneless butts, loin rolls, pork tongues, and sausage meats are further discussed under Chapter XII.

Spareribs. Spareribs may be packed 260 pounds per tierce, with 15 pounds of fine salt and 12 ounces of saltpetre sprinkled between the layers, and the tierce filled with sweet second pickle. At time of shipment to hot climates spareribs may be repacked with 100° plain pickle and 50 pounds of capping salt per tierce.

Wiltshires. These sometimes may be cured in sweet pickle for ten days then dry salt cured for the remainder of the curing period (about fifty days).

c. Beef. Beef is likely to become salty, unpalatable and dry when cured, however, beef cuts, trimmings and offal may be cured by dry preservation, or pickled then barreled, smoked, dried, canned or made into sausage or other prepared product.

(1) Dry Preserved Beef. In general, desiccation may be used alone or in combination with other processes, as curing, for the preservation of meats, fish, milk, eggs, blood and other products. The surface of cured meats as smoked hams and bacon, dried beef and sausage and of fresh meats, during storage, is maintained in as dry a condition as practicable as an important aid in their preservation. Pork fat backs may be rubbed with paprika and dried in the air as "paprika bacon," cured pork products as Westphalia and Italian hams may be dried over a long period.

Meat is dried in various parts of the world in strips or may be made into a powder. This includes "jerked" beef, charque, biltong, carne Tassajo, carne secca and pemmican. The meat may be cut into strips and dried quickly in the air or over a slow fire, with or without the addition of salt, sugar or flour. Sometimes the strips of meat will be first leached in brine before drying. Smoking may or may not ensue. Usually dried meat is tough and unpalatable and is likely to become rancid. Dried meat furnishes a poor medium for bacterial growth. Pemmican may be prepared from venison, fish or beef by cutting the meat into strips, drying, pulverizing and adding an equal amount of fat. Currants or other fruits may also be added. Meat powder or flour is made from meat which is ground to a pulp, dried, milled to a fine powder and mixed with salt. Usually this product has a burnt flavor.

Dehydrated meat may be prepared for use where there is difficulty attending the handling, storage, and shipment of fresh meat. Under ordinary storage conditions properly dehydrated meat does not deteriorate to any appreciable extent and is useful in emergency rations in hashes, soups and stews where fresh meats are not available. The common air blast method of dehydration of pieces of meat, results in the formation of a crust on the exterior, prevents evaporation from the interior and thus requires such a length of time that a certain degree of decomposition may result before satisfactory dehydration has occurred. The modern vacuum method of meat dehydration consists of placing about 100 to 200 pounds of meat cut into pieces of suitable size, as cubes up to 1 inch in diameter or thin slices, into a vacuum pan, on metal gauze shelves in direct contact with pipes through which

hot water flows continuously, and maintaining a vacuum pressure. Under these conditions dehydration may occur in twelve hours or less.

The concentration of meat juices for the manufacture of beef extract and bouillon cubes is discussed under Chapter XIII; desiccated, malted and condensed milks in Chapters XIX, XX and XXI; desiccated eggs in Chapter XV; dried fish in Chapter XVI, and sausages in Chapter XII. Also see trichina rulings under pork trimmings, Chapter VIII.

(a) Beef Cuts. Shoulder clods, boneless square cut chucks and other boneless beef cuts may be cured for export with a dry curing mixture containing salt 8 pounds, sugar ½ pound, saltpetre 4 ounces and second sweet pickle 1 gallon, per hundred pounds of meat. The meat is sprinkled with the curing mixture and about 283 pounds are packed in a tight, muslin lined tierce. The tierce should be packed full to entirely exclude the air. The cured meat may be shipped in thirty days. A shrinkage of 1 per cent is allowed.

Dried beef is discussed under "3. Smoking."

(b) Beef Offal. (See Chapter VIII, "Offal—Beef.")

(c) Beef Trimmings. (See Chapter VIII, "Trimmings—Beef.")

(2) Pickled Beef. (a) Beef Cuts. *Barreled or Plain Pickle Beef.* Mess Beef. This includes straight plate beef and assortments which may contain plates, flanks, briskets and square cut chucks. Briskets may be cut through at the joints and blade bones loosened with a knife to facilitate curing. Mess beef may be cured in open vats, closed tierces, barrels or smaller packages. About 1200 to 1500 pounds of beef may be packed in a vat, 300 pounds in a tierce or 200 pounds in a barrel. The meat is rubbed with about 1½ pounds of fine salt per hundred weight and 3½ pounds of capping salt sprinkled between the layers and then cured with 70 to 100° plain pickle containing 2 to 3 ounces of saltpetre to each hundred pounds of meat. Mess beef may be overhauled on the fifth, tenth and twentieth days and repacked for shipment at twenty-five to thirty-five days using 100° plain pickle and capping salt, 40 pounds per barrel or 60 pounds to a tierce.

Plate Beef. The full plate is usually divided between the 5th and 6th ribs into brisket and navel ends. The navel end may be divided longitudinally into a "bottom piece" and a "top" or "rib piece." The bottom piece may be divided into anterior and middle or navel pieces and a posterior or flank piece. The top or rib piece may be divided into either 2 or 3, rib pieces.

Extra India Mess Beef is made from the highest grade of heavy, fat plates, weighing 65 to 80 pounds with the brisket off, and cut into pieces of about 8 pounds.

Extra Plate (No. 1 or Extra Family) Beef is made from choice plates weighing 50 to 60 pounds with the brisket off and cut into 2 rib pieces and 3 bottom pieces. Usually 10 top pieces are put into a barrel and the barrel completed with bottom pieces.

Regular Plate (No. 2 or Family) Beef is made from good plates, averaging 40 to 50 pounds, packing 22 to 25 pieces of the same assortment as Extra Plate, into a barrel.

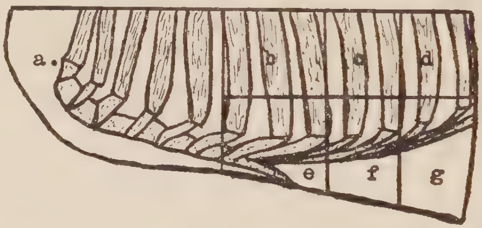


FIG. 49. FULL PLATE BEEF
(From 12 rib forequarter)
(Showing divisions made for barreled beef)

abcdefg, Full Plate; *a*, Brisket; *bcdefg*, Navel End; *bcd*, Top Piece; *efg*, Bottom Piece; *b*, Rib Piece; *c*, Rib Piece; *d*, Rib Piece; *e*, Navel Piece; *f*, Navel Piece; *g*, Flank Piece.

Packet (No. 3) Beef is made from medium plates weighing 30 to 40 pounds.

Common Plate is made from common plates weighing 20 to 30 pounds.

Boneless Rolled Beef consists of plates with brisket off, boned, rolled and wound with cord in rolls weighing 8 to 12 pounds.

Assortments of Mess Beef. A general assortment of mess beef may consist of one plate (brisket off) cut into 4 or 5 pieces, 1 square cut chuck cut into 4 pieces of about 10 pounds each, or into smaller pieces, and 1 rump butt. In addition necks, flanks and briskets may be used.

Prime Mess Beef may consist of 50 per cent plates and 50 per cent of square cut chucks, rumps and flanks from medium cattle. These cuts may be divided into pieces weighing from 6 to 9 pounds. Other proportions of cuts may be used.

Extra Mess Beef is made from assorted cuts from common cattle.

Rump Butt Beef. Rump butts, boneless except for tail bones, from medium and common cattle and weighing 4 to 6 pounds may be packed 185 pounds to a barrel using about $7\frac{1}{2}$ pounds of fine salt between the layers and filling up the barrel with 80° brine containing about 4 ounces of saltpetre. When cured, the meat will weigh about 200 pounds.

Scotch Buttocks from choice rounds are barreled in mild brine for export.

Sweet Pickle Beef Cuts. Beef Ham Sets. Dried beef sets are made from mature cattle, the carcasses of which have been quickly and properly cooled. The sets are thoroughly chilled, graded according to quality and weight and cured as sets or the insides, knuckles and outsides cured separately, in open vats or in closed tierces using a sweet pickle. In vat curing, about $4\frac{1}{2}$ gallons of pickle are used per hundred weight of meat. In tierce curing, about 318 pounds of meat and 8 to 12 gallons of pickle are placed into each tierce. Overhauling may be accomplished on the tenth, twentieth and fortieth days. Usually six days per pound weight at 36°F. or eight days per pound weight at 28 to 30°F. are allowed for curing sets. Sets may be cured in seventy-five to one hundred and twenty days. Outsides may be cured in forty-five to fifty days, knuckles in sixty days and insides in ninety days. Beef hams gain about 8 per cent in cure. Beef ham sets must be well cured otherwise they may decompose in the smoking and drying operation. In handling dried beef sets, hook and trier holes should be avoided, otherwise green areas will result in the finished product.

Corned Beef. For the manufacture of corned beef, all portions of canner and cutter grades of cattle and especially plates, chucks, flanks and trimmings are used. The better grades of cattle have too much fat, while beef hams are too dry. Frozen meat must be thawed out before being cured. The cattle or cuts are first boned, the larger chunks of meat are divided into smaller pieces readily cured and the bloody, excessive fat, cartilage, ligaments and other gross connective or other undesirable tissues are removed.

Long Cure. A sweet pickle cure consisting of brown sugar $1\frac{1}{2}$ pounds and saltpetre $3\frac{1}{2}$ ounces per hundred pounds of meat and 50 to 60° plain pickle has been used. The meat may be cured in eight to thirty days at 36 to 38°F., depending on the size of the pieces, and other factors. Two or three overhaulings may be made, usually on the third and twelfth days. The meat attains a bright red color and a salt flavor. The long cure process is slow, involves labor at overhauling and requires a large amount of storage space. Briskets when given

a long cure are very desirable for corned beef hash as they contain a quantity of hard fat, and more of a salt flavor is developed in the long cure. The bulk of briskets are cut from cattle aged in the cooler. Old or ripened meat is frequently cured by this method.

Short Cure. In order to save time, labor and curing space, beef may be cured by a force cure wherein second pickle and heat are used to produce corned beef ready for canning in from seven hours to seven days. Short cured corned beef has a bright red color without the saltiness or brackishness which attends long curing.

The meat is cut into smaller pieces, about the size of a fist; soaked in cold water twelve hours to improve the color in the finished product and parboiled from twelve to sixty minutes at 185°F. to shrink the meat. One establishment cooks the meat six hours at 158°F. After sufficient shrinkage, while hot and without soaking, the liquid from the meat is drawn off and hot pickle immediately added. The temperature of the pickle used in three different establishments is as follows: 140°F., 165 to 185°F., and 180 to 190°F. A temperature above 190°F. may destroy the nitrites. The pickle used may consist of three-fourths second pickle and one-fourth fresh pickle. The pickle should contain about 32 grains of nitrites per gallon of pickle. Too large an amount of nitrites is undesirable while a pickle too weak in nitrites may require too long a time to cure at high temperatures resulting in souring of the meat. In lieu of a second pickle, one may be prepared by using 100 pounds of sugar, 100 pounds of saltpetre, and 50 gallons of pure, edible, beef blood to 1000 gallons of 30–35° plain pickle, heated at 105 to 110°F. twenty-four to thirty hours, then quickly pasteurized, skimmed and strained when it is ready for use.

After the hot pickle has been added to the meat, the temperature of both is maintained at 120 to 140°F. and the meat in cure constantly agitated. The length of time in cure depends on the methods employed, pickle used, temperatures and other factors. Corned beef may be ready for canning in six to twelve hours after the hot pickle is added, or an establishment may modify the short cure and require seven to nine days. The shrinkage from the green, boneless weight to the canned weight may be 40 to 45 per cent.

A certain amount of grey centers the size of a dime in large pieces of cured meat is permissible, as after canning, the curing continues and these small centers may disappear.

Saltpetre maintains aerobic conditions in cured meats thus preventing the growth of putrefactive anaerobes, and not as much sourness

is present in meats cured with saltpetre as in plain pickled meats. Saltpetre also converts hemoglobin into a stable nitroso-compound thereby maintaining the red color of the meat.

In salt or plain pickle curing of meats the red color of musculature rapidly disappears and the meat becomes dull gray. When saltpetre is used, this grey color gives place to the red color of nitroso-hemoglobin and nitroso-haemochromogen or other nitroso derivative, brought about through nitric oxide.

Saltpetre is reduced first by bacteria:

$$KNO_3 + {}_2H = KNO + HOH$$

Lactic acid produced in the meat during rigor mortis produces the following:

$$KNO_2 + H(R) = HNO_2 + K(R).$$

$${}_2HNO_2 \text{ is reduced to } {}_2HOH + NO + NO_2.$$

During cure, the oxyhemoglobin of the musculature is changed to methemoglobin then in the interior to hemochromogen. Nitrate is reduced to nitrite chiefly in the pickle. The nitrite is produced in small quantity and diffuses into the meat more slowly than saltpetre. Therefore meat may be found with an outer border colored red with nitroso-hemoglobin while the center contains only hemochromogen which upon air exposure turns grey or dark through the conversion of the hemochromogen into haematin.

One group of analyses made on corned beef gave the following:

	MOISTURE	PROTEIN	FAT	SALT	SALTPETRE
	per cent	*per cent*	*per cent*	*per cent*	*per cent*
Maximum	67.93	28.80	18.02	6.00	0.21
Average	63.86	26.01	8.06	2.80	0.08
Minimum	59.81	23.40	1.92	1.20	0.01

Pump Cure. A force cure used to a limited extent by certain retail butchers where a great increase in weight results consists of injecting blood vessels of fresh, chilled beef tongues or briskets with a certain pickle solution.

(b) Offal (Beef). *Beef Tongues.* As soon as the tongue is removed from a head, it should be thoroughly cleaned of all manure and slime and gross inedible tissues removed with a knife. It is then washed in lukewarm water, rinsed in cold water, hung on a rack, chilled twenty-four hours, trimmed closely, weighed, placed into 80° brine twenty-four hours, then into 80° sweet pickle using 7 to 8 gallons per 100

pounds of tongues. The tongues are cured at 36 to 38°F., overhauling on the fifth and twentieth days. At the first overhauling about 9 pounds of salt per 1000 pounds of tongues is added to each vat. According to weight, (whether under or over 5 pounds) tongues in cure will be ready to smoke or for shipment in thirty to thirty-five days. For shipment tongues are repacked in barrels in 70 to 80° pickle.

In one test on 50,000 beef heads, the average weight of each rough tongue was $5\frac{1}{4}$ pounds, the yield from rough to canner trim was 52 per cent or $2\frac{3}{4}$ pounds. In cure, tongues shrink from $\frac{1}{2}$ to 3 per cent.

Tripe. (See Chapter VIII, "Cattle Offal.")

Sausage Meats. Beef hearts, cheek meat and ox lips may be cured in 70 to 80° plain pickle with saltpetre added, in vats or tierces, overhauled on the fifth, tenth and fifteenth days and cured in twenty-five to thirty days for sausage meats.

d. Mutton. (1) Offal. (a) "Lamb" tongues include all sheep tongues. They should be removed promptly from heads, cleaned and the gross inedible tissues removed with a knife. They may be scalded ten minutes at 140 to 150°F., skins (mucosa) removed by hand, immersed in cold water 15 to 20 minutes, hung on racks in cooler at 34 to 36°F. for twenty-four hours, trimmed, and cured in vats or tierces at 36 to 38°F. in 80° sweet pickle, using 7 to 8 gallons per hundred weight of tongues. Tongues are overhauled at about five and fifteen days and are ready for cooking in twenty to thirty days.

(b) Sausage Meats. Sheep cheek meat and hearts may be plain pickle cured twenty to thirty days for sausage meats.

(c) Miscellaneous. (See Chapter VIII, "Mutton Offal.")

e. Veal. (1) Offal. Calf tongues are used the same as small beef tongues. They may be canned and sometimes smoked.

3. Commercial Smoking. This section includes the preparation of cured pork and beef products before smoking, their smoking and removal from the smoke house.

About 80 per cent of all cured pork cuts are smoked. Dry salt cured backs and sides are not smoked. For domestic trade, dry salt cured short ribs, extra short clears, rib bellies, clear bellies and 3-rib bellies are smoked. For export trade certain dry salt cuts are smoked. Dry salt pork cuts when smoked may be designated, "Bacon Meats;" and dry or box cured, and sugar cured or sweet pickle cured pork cuts, as "Smoked Meats." Dry cured bellies when smoked are termed "Fancy Breakfast Bacon" and sweet pickle bellies, "Breakfast Bacon." Cured beef ham sets, briskets and tongues may be smoked.

a. Preparation Before Smoking. Meats may be soaked, washed or brushed, labeled, strung, hung on trees or placed on racks and allowed to dry before smoking.

(1) Soaking, Washing and Brushing. Soaking schedules as employed by establishments vary considerably. Some packers maintain summer also winter soaking schedules. In soaking meats, clean concrete or tight wooden vats equipped with hot and cold running water facilities to insure plenty of soaking water and to control its temperature, are used. These vats are provided also with drains and overflow pipes. The soaking water should be pure and is usually maintained at 60 to 80°F. It may be changed one or two times on very salty meats. The amount of soaking given meats depends on the kind of meat, nature of the cure, length of time in cure, trade demand and use to which put. Overcured, very salty and hard cured pickle meats heavily pumped and cured in concentrated pickle, are soaked longer than mild cured meats or those which have just completed curing.

A small amount of dry salt pork cuts for domestic use are sometimes soaked in one or two changes of water, one to six hours to remove the excess surface salt. Usually they are not soaked but placed on a table where the surface salt is brushed off with a clean broom, or washed off with a spray of water. Export cuts may not be soaked. Sweet pickle pork cuts are usually soaked, fancy bellies one-third to one hour, fancy hams one and one-half to eight hours and second grade bellies and hams three and one-half minutes per day in cure and not to exceed eight hours. Dry cured bellies cured under twenty days may not be soaked and if from twenty-one to forty days or over, ten to thirty minutes. Cured beef ham sets may be soaked twelve to twenty-four hours. In summer, meats may be soaked somewhat less than during winter.

An average soaking schedule employed by one establishment is as shown on page 320.

(2) Labeling. Pork cuts may be placed on a moving table where strings or comb hangers are inserted, sprayed with warm water, dried with compressed air and hand scrapers, and ink branded with the establishment trade label, before smoking. The ink used should conform with sanitary requirements. (See Chapter VII.) The brand is usually placed on the skin which has been scraped free from excess moisture. Each cut should also show the inspection legend of the official inspection agency. Dried beef sets and beef tongues usually are branded with a hot branding iron after being smoked. The color-

ing and drying of these products in smoke would obliterate any brands placed on them before smoking.

(3) Hanging. After branding, pork and beef cuts and beef tongues are suspended on clean smoke trees or placed on wire smoking screens. Heavy bellies may be suspended by two strings inserted into the flank or shoulder end about 3 inches from the edges and 2 inches from the end. When hung by the flank end, the weight of the heavier shoulder end prevents the flank end from drawing up in smoke. However, "dog ears" may form which are unhandy when wrapping. When hung by the shoulder end, sourness is sometimes noted in the string holes after smoking but does not always follow. Extra short clears

AVERAGE SOAKING SCHEDULE

PRODUCT	NUMBER OF WATERS (AT 70–75°F.)	MINUTES SOAKED PER DAY IN CURE	MAXIMUM SOAKING PERIOD
			hours
D. S. Hams	2–3	10	10
Export Hams	2	10	8
D. S. Shoulders	2	4	7
D. S. Bellies	2	5	12
Export Bellies	1	1	1
D. S. Butts	2	10	12
S. P. Fancy Hams	1	3	6–8
S. P. Regular Hams	2	3–3½	6
S. P. Shoulders	2	3½–4	7
S. P. Bellies	2	3–3½	6
S. P. Brisket Ends	1		½
D. C. Bellies	1		½
Beef Ham Sets	2–3		10–24
Beef Tongues	1–2	5	15

may be divided into anterior and posterior halves, and hung by the belly side, using two strings placed about 3 inches from the ends and 2 inches from the belly edge.

Light bellies are usually hung with strings or galvanized wire combs (hangers or stringers having a row of nail-like prongs) inserted into the tougher, flank end. Pork hams may be suspended by a cord strung through and wrapped around the shank. Sometimes hams are stuffed into a stockinette covering which by absorption of fat during smoking decreases the shrink of the product. Pork brisket ends and bacon squares may be spaced on wire smoking screens placed on smoking trees.

Beef knuckles, insides and outsides are hung by the thinnest ends (or shanks). Beef briskets may be suspended by the "point of the breast." A beef tongue is strung by the gullet (larynx) and a half-hitch is made around the fat part to keep it from folding over the tongue. Provided the gullet is absent, a string may be inserted into the thick base of the tongue, using a needle.

After hanging, the loaded trees are run into the smoke house 12 or more hours before starting the fire. Usually hams are placed in the first room above the fire pit and fancy bellies in the top floor. In the smoke house the pieces of meat should be evenly spaced so as not to contact each other or the walls, otherwise the areas which touch will not be smoked or dried sufficiently but will remain pale in color, more or less soft or moist, and are liable to sour.

When first placed into a smoke house, most meats will drip due to condensed moisture or that from the soaking vats. If this moisture falls on meat hung in lower compartments of the smoke house, staining of the meat results, therefore the top floor of the smoke house should be filled first and after the drip has subsided, the next lower floor, and so on. Usually the doors of a smoke house are kept open two to six hours or until the drip has subsided and the pieces are almost dry, then closed and a fire started on the gound floor to produce the smoke.

b. Smoking. Wood smoke is produced and distributed in smoke houses in conjunction with heat and air circulation to preserve, color and flavor cured meats. Smoke is evolved by the burning of wood or sawdust; and heat, by the burning of wood, by a gas flame or by steam enclosed in pipes. (See "1. General.") It is claimed that soft wood does not produce the amount or quality of smoke that hardwood does. Many establishments burn hardwood sawdust, using wood or a gas flame to produce the desired heat while others burn only sawdust and produce heat by means of steam enclosed in pipes. Hickory and maple woods are used extensively and impart very desirable flavors to cured meats. In smoking Westphalia hams, juniper berries and twigs may be used.

Preservation to a small extent is promoted by a certain amount of desiccation, absorption of gases and fumes and by an outer coating of creosote, pyroligneous acid and other substances from wood smoke, which also color and impart flavors and increased palatableness to the meat. By the extraction of some moisture, cured meats become firmer and more easily handled. In addition there is some loss of fat. Dryness is essential in smoked meats to be stored a long time or for export.

All meats to be smoked must be thoroughly cured or spoilage will result at smoking temperatures. An uncured center in a ham may result in gaseous decomposition and a puffed ham.

(1) Smoke Houses. Smoke houses vary greatly as to type, size and height. Small makeshift smoking compartments may be made from barrels and boxes. A small smoke house, having a capacity of 500 pounds may consist of a single room equipped with beams having nails or cross sticks on which cured meats are suspended for smoking. Large smoke houses capable of holding 35,000 pounds of meats may consist of a large shaft having a series of compartments, usually 3 to 5, one over the other separated by iron gratings, with a fire pit at the bottom and a roof on top. The walls should be of brick or other non-inflammable material and at least 13 inches thick to retain heat and to protect the house from varying outside temperatures. The fire pit is at least 4 to 6 feet below the first floor and is equipped with a door having openings to regulate the draft. In cold climates the roof may be double or equipped with a false ceiling to prevent condensation on the ceiling. A ventilator which can be easily manipulated is placed in the roof to control temperatures during smoking. Steam coils may be installed in smoking compartments to insure a uniform heat. Doors into smoke house rooms should be of metal and ample in width. Overhead tracks may be installed in smoking compartments avoiding the use of wooden beams and supports. Metal smoke trees, each capable of holding 200 to 600 pounds of meat are suspended by trolleys from these overhead tracks and are easily run into or out of the smoke houses. A smoke house may be equipped with gas and an automatic temperature control where hardwood sawdust is used. Smoke houses should be separate from all manufacturing compartments. (Also see Chapter XII.)

(2) Smoke and Heat. A pile of sawdust may be placed in the center of the fire pit and some burning wood laid around it to ignite the sawdust. A dense, heavy, dry smudge will result. If sawdust is thrown on a blazing fire it may ascend through the house in the form of a light ash and settle on the meat. Sawdust in well distributed small piles may be ignited from other fires. Sawdust may be banked near a perforated gas pipe and gas burned with a slow delivery to produce smoke. A light or heavy smudge with varying degrees of heat, as a "hot" or "cold" smoke may be obtained.

Commercial smoking temperatures vary from 100 to 135°F. The temperature in different parts of a smoking room may vary 10°F. due

to loose fitting doors, drafts or the irregular placement of the fire. The compartment nearest the fire is usually the warmest. An even distribution of heat and smoke throughout all smoking compartments should be secured and maintained. Forced air circulation in conjunction with gas burning and hardwood sawdust and properly placed steam pipes, tend to produce a well distributed smoke and even temperature. The temperature should not be maintained so high as to melt fats and cause fat dripping and wrinkling of the skin of meats, or so low that meats will remain pale, soft and moist. Smoking usually begins with a hot smoke of 125 to 135°F. to dry the outside of the meats in a short time (about three to eight hours) giving them a partially glazed appearance and warming them through. The temperature of the smoke is then reduced 10 to 15° before the fat has a chance to soften from the heat, and the smoking finished at 110°F. Some establishments maintain a temperature of 112 to 118°F. for five to eight hours then increase it to 115 to 120°F. A standard thermometer should be used to record temperatures. The shoulder end of bellies and the butt end of hams should be warm to the hand but not dripping.

(3) Time. No definite time is used in general to smoke cured meats. Commercially it may vary from six to thirty-six hours depending on the color desired, whether a light or heavy smoke, the size and shape of the pieces, degree of heat and other factors. For domestic use it may average twenty-eight hours, but for export and tropical countries dryness is essential to aid in preservation therefore such meats may be smoked and dried two to four days at 105 to 115°F. to secure sufficient shrinkage. Ordinarily dry salt meats may be smoked 96 hours at 105 to 115°F., dry cured bellies fourteen hours at 120 to 125°F., sweet pickle hams eighteen to twenty-four hours at 115 to 125°F. and picnics fourteen to sixteen hours at 120 to 125°F. A well smoked product should have a bright cherry amber color, not too light or too dark and a firm, dry exterior. Ham and shoulder shanks may indicate the degree of smoking as they are the slowest to dry.

Beef hams may be smoked and dried four to eight days depending on the weight. Usually they are smoked for three days at 130 to 135°F., then smoking is discontinued and steam turned into pipe coils arranged on the ceiling of each compartment, and the drying process continued for two to four days gradually reducing the temperature to about 115°F. Cured dried beef sets have scarcely any fat and can be smoked a longer period and at a higher temperature than pork. Thorough drying of this product is essential.

(4) Shrinkage in Smoke. This varies according to the method of cure, character of the meat, length of time in smoke and temperatures employed. Dry salt meats shrink less than sweet pickle meats; solid fat less than soft or oily fat or lean meat, and meats subjected to a low heat and a shorter period of time less than where a greater degree of heat is maintained or over a longer period of time. Careless smoking and handling may cause excessive shrinkage while too hasty smoking, may allow too much moisture to be retained in the meat. The percentage of shrinkage does not vary as greatly for dry salt meats as they do for sweet pickle meats. The shrink on fat cuts for domestic trade as fat backs, clear plates and jowls will average 5 to 7 per cent and on cuts containing mostly lean meat such as ribs, short clears and bellies 5 to 8 per cent based on weights free from salt. For ordinary domestic trade, based on weight after drainage is allowed, sweet pickle hams and shoulders will shrink approximately 6 to 10 per cent and bellies 10 to 14 per cent. Export meats smoked six to eight days may shrink 11½ to 17 per cent. Beef hams may shrink 25 to 40 per cent and beef tongues 8 to 10 per cent.

One establishment estimated the following shrinkages:

PRODUCT	TEMPERATURE	SMOKING TIME	SMOKING SHRINKAGE
	°F.		per cent
Dry Salt Meats:			
Hams	90–105	4– 8 days	8–12
Export Hams	105–120	2– 6 days	10–14
Shoulders	110–125	6–16 hours	4– 7
Bellies	105–120	12–24 hours	3– 5
Dry Cure Bellies	110–125	12–24 hours	6–12
Sweet Pickle Meats:			
Fancy Hams	110–120	12–28 hours	5– 8
No. 2 and No. 3 Hams	105–130	12–24 hours	5– 8
Shoulders	105–120	12–26 hours	6– 8
Bellies	105–126	8–24 hours	8–10
Beef Hams	115–135	5– 7 days	25–40
Beef Tongues	110–125	6–12 hours	8–10

Another smoking schedule allowed the following shrinks:

PRODUCT	HOURS IN SMOKE	SHRINKAGE
		per cent
Dry salt ribs, short clears, extra short clears and bellies over 20 pounds	20–26	5
D. S. fat backs, plates and butts	12	4½
Dry cured bellies	16	12
Sweet pickle fancy hams	24–26	7
Regular hams	24–28	6½
Regular skinned hams	24–26	5½
S. P. Picnics	20–26	7
S. P. Bellies	24–28	9–10

TEST ON SWEET PICKLE BELLIES

AVERAGE WEIGHT	DAYS IN CURE	GAIN IN PICKLE	SHRINK FROM PICKLED* TO SMOKED WEIGHT	SHRINK GREEN TO SMOKED WEIGHT
pounds		*per cent*	*per cent*	*per cent*
10½	46	10.20	13.05	4.18
10	43	9.92	15.14	6.72
10	42	7.87	12.68	5.81
10½	42	9.19	13.29	5.33
11½	44	7.83	14.52	7.83

* All meats drained twenty-four hours before weighing.

TEST ON SWEET PICKLE HAMS

AVERAGE WEIGHT	DAYS IN CURE	GAIN IN PICKLE	SHRINK FROM PICKLED* TO SMOKED WEIGHT	SHRINK GREEN TO SMOKED WEIGHT
pounds		*per cent*	*per cent*	*per cent*
14	51	2.93	6.28	3.53
14½	55	2.48	7.67	5.38
14½	51	3.74	6.80	3.31
14¾	51	1.54	7.77	6.36
15	52	1.88	7.76	6.03

* All meats drained twenty-four hours before weighing.

Another test on meats cured 62 days and then soaked in 2 waters at 70 to 75°F. gave the following results:

PRODUCTS	GAIN IN SWEET PICKLE	LOSS IN DRY SALT	MINUTES SOAKED PER DAYS IN CURE	HOURS IN SMOKE	LOSS IN SMOKE	NET LOSS IN CURE
	per cent	*per cent*			*per cent*	*per cent*
S. P. Hams..........	7.3–11.9		4	24–26	11.4–13.1	0.35– 5.3
S. P. Picnics..........	12.0–25.6		4½	21	15.9–22.0	0.5 – 9.5
S. P. Bellies..........	7.0–16.0		4	22	15.0–23.0	4.3 –13.7
D. S. Bellies..........		0.78–5.6	5	16	6.9– 8.0	8.3 –13.8
D. S. Shoulders......		0.0 –6.3				

(5) Electric Smoking. It is claimed that where an electric current is used under certain conditions with a twenty to thirty minute smoke that a light amber color will be produced on hams and bacon; that any color from the lightest to the heaviest smoke can be obtained with little shrinkage; that the smoked meat will be firm and retain delicate flavors; and that a general saving in time, labor and material will result. This system of smoking has been tried out to a certain extent.

c. Removal from Smoke. When smoking is completed, the fire is extinguished, the house opened up to afford a free circulation of air and the smoked meats allowed to cool and dry. Cooling is expedited if the meats are removed from the smoke house away from the heated walls. After their removal, smoked meats should be handled as little as possible, otherwise they may become dull, greasy, and with an undesirable, unattractive appearance. Usually meats are not handled from the time they are hung on the trees until after smoking and cooling. The cooled, smoked meats are run to a packing bench where they are inspected and packed ready for shipment.

4. Packing, Storage and Shipment. a. Pork Products. (1) Dry Salt. Dry salt meats may be removed from cure and shipped interplant in refrigerator cars properly bottom and side racked and the cured meat piled skin side down except the top layer which is piled skin side up.

Commercially, when removed from cure for export shipment, domestic dry salt pork cuts may be brushed free from surface salt or washed and dried, weighed, then packed in boxes of 500 pound capacity, using from 25 to 80 pounds of salt per box, or packed in barrels or other containers, and kept under chill room temperatures.

Commercially, cured English meats may be exported packed in boxes in borax or salt. When they are to be packed in borax, they are washed, and if slimy or old they are scrubbed, the edges and skin are scraped, each piece is wiped with cloths wrung in hot water, rubbed

with fine English salt and borax, then packed in boxes with a net capacity of 500 to 600 pounds. Usually 5 to 6 pounds of borax are rubbed on the meat which is packed in a box. Not more than one-third of 1 per cent of borax is permitted in meat upon its arrival at destination.

Meats packed in salt need not be washed but may be brushed, scraped and wiped.

Dry salt cured pork cuts may be held six months or more in storage in a clean, dry, well ventilated cooler. Such meats should be frequently inspected and when pieces become bare or ends slimy they should be overhauled and re-salted.

(2) Sweet Pickle Meats. For domestic use sweet pickle meats are shipped in bulk only for interplant shipment, and in refrigerator cars properly bottom and side racked. For export they may be packed in boxes using borax.

(3) Plain Pickle Meats. The packing and shipment of these are discussed under "2. Curing."

(4) Bacon and Smoked Meats. These may be inspected, weighed, and packed, wrapped or unwrapped, in crates, boxes or other containers or cut into pieces or slices and packed in cartons, boxes or cans. Trade and inspection labels or brands may be attached to the product, wrappings or placed on the containers. The net weight and volume law requires that all wrapped smoked meats have the net weight of the contents of individually wrapped packages shown. Weighing may be conducted by hand or on an automatic machine which also stamps the net weight on the wrappings.

There are many kinds of wrappings, containers, methods and details of packing and handling smoked and bacon meats, depending on the trade demands, locality of consumption, distance to be shipped, time of year, and contemplated period in which the meat is to be consumed.

Smoked meats may be shipped unwrapped for local delivery during especially cold weather when there is no danger of skipper infestation. For domestic shipment they may be wrapped in oiled, glassine or other non-absorbent paper; in absorbent paper or in muslin, stockinette or other cloth wrappings. Fancy meats may be wrapped in parchment paper while cheaper cuts may be packed loose in boxes or other containers lined with paper.

Export hams may be packed in large barrel-like containers of about 500 pounds capacity and which contain holes in the sides and ends for ventilation. They may also be wrapped in paper and muslin and packed in slack barrels holding 200 to 250 pounds.

For tropical countries, smoked meats should be so wrapped and packed as to afford protection against pests and vermin. They may be wrapped in paper, tied, securely sewed in an outer covering of muslin and dipped in some wash or other preparation. The "washes" which have been employed are a white wash of alum, lime and water glass in water and a yellow wash.

Hams and bacon which have been properly wrapped in paper and muslin may be enclosed in an air tight, flexible covering by dipping in asphaltum, deodorized tar or similar substance. These coverings are prepared according to private formulas which are considered trade secrets. One packer states his method to be as follows: Hams or bacon are wrapped in glassine paper, and stockinette, dipped in hot, common pitch until covered, then hung to dry. They are inspected for air crevices, and packed in boxes of about 101 to 107 pounds net. Various preparations of hot vegetable oils and lard have been used to coat the outside of hams to prevent mould. However, these fats may become rancid.

Air tight coverings are used to exclude vermin, and the growth of mould. Dipped hams and bacon are usually packed in ventilated crates or other containers, the openings of which are screened against pests. Instead of dipping, smoked meats may be wrapped in burlap and packed in containers in oats or rice hulls. One old fashioned but effective method is to packed smoked meats in dry wood ashes over a period of many months.

One packer uses the following boxes for general and special use in packing smoked meats:

CAPACITY	USED FOR
pounds	
25	Bacon
30	Insides (Beef)
50, 75, 100 and 150	General
100	Bellies
100	Extra Short Clears
200	Ham and Bacon and Dried Beef, Export

Slack barrels, 200 to 250 pounds are also used for general packing.

Bacon may be sliced and packed into cartons, boxes, glass jars or cans. Bellies that are intended for slicing purposes, usually have most of the rind, except on the shoulder end, removed on the cutting

floor; dry cured, and then given a longer smoke than for domestic trade to prevent slices from becoming mouldy in containers. One packer uses the following specifications. Slicing bacon to be not less than 7 or more than 11 inches wide and not less than $\frac{3}{4}$ or more than $1\frac{1}{2}$ inches thick. If any thicker the fat part is trimmed away until the desired thickness is attained.

The bacon is then chilled to provide for even thickness to the slices. One establishment places the bacon in a cooler at 27°F. for six to eight hours then into a second cooler at 24 to 27°F. for twenty-four hours. This chilling stiffens the bacon. The bacon is sliced with a machine run by hand or by power. About 12 slices are made per inch, however, any desired size may be cut. Some establishments maintain a high state of sanitation in the slicing and packing rooms, the bacon not being touched by hand from the time it is removed from the smoke trees until shipped out in the final package. Slabs of bacon may be handled with clean wooden forceps. Slices of bacon coming from a power slicing machine may fall upon a sanitary metal tray resting on a scale. These scales may be so adjusted that when a certain weight of sliced bacon has fallen on a tray the scale beam rises and automatically stops further slicing until the loaded tray is removed. An empty tray is then placed on the scale and slicing resumed. The sliced bacon may be packed into cans (see Chapter X), glass jars, cartons or boxes by means of flat-jawed metal forceps.

Bacon trimmings are used in potted meats and the ends and short slices used for lower grade bacon, usually for rapid consumption. One packer uses $\frac{1}{2}$, 1, 5 and 10 pound paper cartons, glassine wrapped. These $\frac{1}{2}$ pound cartons are then packed in larger cartons holding 6 pounds; and the 1 pound cartons in 6 and 12 pound packages. Five and 10 pound cartons may be of triple slide, corrugated paper construction and are used generally for the lower grade bacon.

The keeping qualities of smoked and bacon meats depend upon the soundness of the product, sanitary condition of all rooms, equipment and methods employed, the kind of cure, amount of desiccation attained during smoking, the wrapping, packing and conditions in storage. Dry, hard cured meats, heavily impregnated with salt keep longer than mild or sweet pickle cured meats. A longer smoking period is beneficial, as the greater the amount of desiccation, the better meats will keep. Storage rooms should be dry and packages or pieces of smoked meats so arranged or spaced to permit of good air circulation. A relatively high humidity or stagnant air circulation may promote con-

densation of moisture on stored meats and augment bacterial and mould growth. (See Inspection in Storage.)

Meats hung in a room at a steady temperature may show a slight gain. If held ten days before packing they are apt to become mouldy.

Ordinarily, smoked meats are not designed for long keeping, but after smoking and cooling they are inspected, weighed, wrapped, packed and shipped within two days, and should not be kept in storage longer than seven to thirty days according to conditions. Under the most favorable conditions of desiccation, long smoke and dry storage at 55 to 60°F., sweet pickle smoked meats have been kept as long as sixty days. Thoroughly dried, smoked meats may keep over a period of time in paper wrappings at 55 to 60°F. It is better to remove the wrappings and hang the pieces up separately free from contact to prevent mold. It is not advisable to hold smoked meats in a cold room and later handle, transport or store at higher temperatures, as moisture condensation will result on the meat surface with bacteria and mold growth.

(5) Miscellaneous. Pickled pigs' feet may be packed in 45 grain vinegar in hardwood tierces, barrels; half, quarter or eighth barrels or in kits. Pigs' feet are sometimes cured in brine, and packed in salt and shipped in 25, 50, 100 and 220 pound or other sized boxes. Pigs' feet may be dry salt cured, smoked and packed for export. Pork hocks, snouts, and tongues may be packed in glass containers (see Chapter X).

b. Beef Products. (1) Plain Pickle. The packing of mess beef is discussed under "2. Curing."

(2) Sweet Pickle. After smoking, dried beef sets and tongues have the inspection legend affixed with a hot branding iron. Dried beef may be hung, properly spaced, in a dry room, free from moisture as steam or fog vapors, and provided with good air circulation. Before packing for shipment each piece should be tried to eliminate any with uncured centers which have undergone decomposition changes through exposure to the long, high temperature in smoke. Dried beef may be packed in bulk in large, light weight barrels and shipped, or sliced and packed in cans (see Chapter X), glass jars, cartons or boxes.

Insides, knuckles, outsides and shoulder clods have been used for sliced beef. Clods are inferior to beef hams due to a greater amount of connective tissue. Outsides are not as desirable as knuckles, while the insides are the best for dried, sliced beef. Fat pieces are undesirable as rancidity may result. Bull hams being full, meaty and free

from undesirable fat are very desirable. The outside is flat and thin compared to the inside which is heavy and thick.

Pieces of dried beef to be sliced are first trimmed of all tag ends, loose, discolored or over hardened tissues and outside fat. They may be placed on floor racks at 34°F. for forty-eight hours to chill. This chilling is said to facilitate slicing and to prevent crumbling. The slicing is done in a power or hand slicing machine having an automatic feed to insure uniform slices, the thickness of which can be regulated. Usually 24 to 32 slices are made per inch. The drier the meat the lighter will be the color of the slice. The inside yields large slices, of an even, bright color and of uniform texture. Knuckle slices are smaller, darker in color, bean shaped and divided by connective tissue septa into 3 distinct parts. Outside pieces are drier, and are divided into 2 parts, one of which shows a fine grain and light color and the other a coarser grain and darker color.

The stub ends may be further sliced in a special machine to make "chipped" beef. Stub ends and trimmings are also used in potted meats and other products.

Sliced beef is packed in cans (see Chapter X), glass containers, cartons and wooden boxes. One-half, 5 and 10 pound size paper cartons wrapped in glassine paper may be used. The ½ pound packages are packed 10 in a large carton. Triple slide corrugated boxes lined with glassine paper and holding 5 to 25 pounds may be used when sliced beef is to be consumed within two weeks, otherwise it is liable to mold.

5. Veterinary Examinations. a. General. The veterinary examinations of cured meats intended for troops, including both sanitary and procurement inspections, begin with a consideration of the sanitary source of such products; include their selection, grading for quality, condition, trim and weight; and the supervision of the sanitary requirements of cutting, trimming, grading for cure, pumping, placing into cure, overhauling, authorized ingredients used, manufacture of curing mixtures or pickles, brushing, washing, labeling, hanging, smoking, weighing, wrapping, stamping of packages or other manipulation, handling, storage, shipment, receipt and issue, with such reinspections as are required. It also includes the sanitary location, construction, equipment and methods of operation of meat establishments involved, as defined in Army Regulations (see Chapter III).

b. Inspections prior to Purchase. The inspection prior to purchase is the examination made during manufacture or when cured meats are offered for sale to the Government at purchasing points or in the

field and includes an examination for sanitation and soundness. In any event the inspecting veterinary or medical officer should be informed a sufficient length of time in advance when and where products are to be prepared, the date when they are to be placed into cure, dates overhauled, date into smoke, date removed from smoke, the date of packing and other data and the dates when products are to be presented for final inspection before acceptance. Every opportunity and facility should be furnished and veterinarian for the proper inspection of all products. The primary inspection of cured meats for specification requirements is seldom made at destination. A reinspection for soundness, quality, quantity and package or other examination may be made at delivery before final acceptance.

(1) Sanitation. Strict cleanliness, sanitary conditions, uniform methods, system, and careful handling in all stages of the production of cured products are essential to insure a low percentage of unsound or inferior meats. Compartments should have properly constructed walls and ceilings, floors in good repair, good drainage and ventilation and adequate light. Equipment and machinery should be well constructed with appropriate materials used in their manufacture, and in repair. Tables, benches, cutting blocks, chutes, trucks, knives, saws, meat hooks and racks, should be cleaned and scalded daily and kept clean and sanitary at all times. Tierces and vats to be used should be thoroughly washed, then steamed and when practicable, sunned. Cleanliness should be observed in handling products. Refrigeration in curing cellars should be regular. There should be an absence of foul odors, rodents, roaches and flies. All personnel should have clean outer clothing and freedom from filthy habits and open wounds on fingers or hands. All ingredients used should be authorized, suitable, clean and sound.

(2) Selection. (a) Special Manufacture for the Army. Products which are given special preparation or manufacture for the Army include bacon, hams, shoulders, salt pork, corned beef, salt beef, beef tongues, meat flour for emergency rations, tripe and others as may be specified from time to time. Selection of the chilled products may take place in the cutting or offal rooms, coolers or curing cellars. Products should be handled as quickly as practicable from the cutting or chill rooms into the curing cellars or rooms, transported preferably in trucks, as chutes or similar contrivances may crush or alter the shape of cuts. Cuts should be placed into cure the same day as produced, or kept dry, free from contamination and under refrigeration.

Soundness. Meats should not be selected for Army contracts if from animals which have not been given proper ante-mortem and post-mortem examinations in accordance with Army Regulations as shown by the presence of the stamp of an official and competent sanitary agency, when their subsequent handling and storage were insanitary or unsatisfactory or when any physiological defect or unsoundness exists. If frozen meats are permitted and are to be used, they should be defrosted before examination.

Bellies, extra short clears, hams, shoulders or other cuts of pork should be free from sexual odor; "seedy" belly; hair; scurf; blood clots; rust stains or discolorations; contaminations from dirty water, bile, urine, feces, pus, blood or from the floor; discolorations as hematogenous, filth, icteric or melanotic pigmentations, undue redness or erythema from any cause; injuries as bruises, wounds or hemorrhages; diseased conditions as abscesses, necrosis or lesions of cholera or of urticaria; parasitic lesions as of mange; and deteriorations or other conditions as sourness, mould, sliminess, and cooked skin. Small bruises or hemorrhages which seem insignificant or are unnoticed in chilled products may become so prominent in smoking as to cause their exclusion.

The sanitary inspection of beef at selection is discussed in Chapter VIII, "Beef Trimmings" and "Offal." Cattle, which have been badly bruised, thin or emaciated, having large adhesions or abscesses, removal of the pleura, evidence of disease or unsoundness or if slippery, slimy, mouldy or partially decomposed, should be rejected for Army products. Bloody, sloppy and bruised pieces of meat are undesirable.

Quality. Pork Products. Good quality as it relates to pork products implies that such have passed the required veterinary examinations for soundness; that they are from recently slaughtered, healthy swine in prime condition and have been properly chilled, handled and stored; that they are firm; having desirable quality of fat, lean, skin and bones; a proper proportion of fat and lean; and freedom from undesirable tissues and qualities.

Army Bacon. Army bacon comprises clear bellies, extra short clears or other cuts of pork as may be designated, prepared and accepted under War Department specifications. During the World War both clear bellies and extra short clears were dry salt cured and smoked in the preparation of this product.

Thoroughly chilled bellies within four days of slaughter, and if possible cut after date of award, are desirable. Avoid old cooler stock or that

showing cooler age. If freezer stock is permitted and is to be used, it should have been properly chilled after slaughter, cut and placed into the sharp freezer within four days of slaughter, and at time of inspection properly thawed out. Bellies should be firm and not un-chilled, soft or flabby.

Bellies or clears from boars, stags, cryptorchids, or old sows; of an inferior grade, shelly, too fat or too lean; or containing tears or cuts from deep scribing, are undesirable. Old sow bellies are usually "seedy." The fat should be white and firm and not oily or soft. Oily fat never firms out, is wasty, does not cure well and is undesirable. The musculature should be bright red, fine fibred and not rough or coarse fibred. The skin should be light, thin, soft, flexible; free from bristles, hook holes, cuts or "dug outs;" and not thick, heavy, coarse, rough, wrinkled or discolored.

Salt Pork. This may include regular or family back or other pork as specified.

Hams. These include American short cut hams either dry salt or sweet pickle cured. Hams from boars, stags and old sows; soft or oily; and burnt out stock are undesirable. Reasonably lean hams of good quality with thickness of fat in proportion to the weight of each ham, are desirable. Usually hams with fat more than 2 inches in thickness are excluded. Hams should not show thick rind or coarse muscle fibre. Hams with tears, hook holes or too closely faced should be rejected.

Shoulders. These may include picnic shoulders or "calas." They should be solid and firm and meet the same general requirements of quality as discussed under "Hams."

Beef Products. *Beef, Salt.* This may be mess beef from good quality cattle.

Meat Flour. This may be prepared from fresh beef hams, flank steaks, square cut chucks or other parts as specified. Mature lean beef is desired. That from veal, canners or bulls is not desirable. One requirement states that beef must be in the chill room three to four days and used within four hours after being removed therefrom.

Corned Beef. (See Chapter VIII, "Beef Trimmings.") Beef intended for Army corned beef, which is canned, should be from dressed carcasses of recently slaughtered cattle in *good* condition. Fat cattle are undesirable as too much fat in the finished product renders it objectionable to the taste and in appearance. Thin animals, bordering on emaciation and bulls are not desirable. Well nourished cutter or

canner cattle, having a small amount of firm fat and whose musculature is firm, bright colored and dry, are desirable. If possible, carcasses should be inspected on the rail before they are quartered. All portions with the exception of gross fats, kidneys, bones, cartilages, tendons, ligaments, flanks, shanks, skirts, hanging tenderloins and bloody end of the neck, may be used. Usually square cuts chucks, plates and trimmings are used. Flanks, hanging tenderloins and skirts contain coarse, stringy, loose muscle fibers which are undesirable. Frequently fibrillar muscular rupture is present in the muscular portions of the diaphragm. Shank meat when processed has a considerable amount of "jelly." Blood clots or blood infiltrated tissues show up as black spots or as dark meat in the finished product. Offal meat as hearts, tongues, cheek and head meat should be excluded. Beef hams and chucks when used alone produce too dry a product and should be supplemented by using fat pieces as from the plate. Chuck meat makes a darker corned beef than does plate meat which carries more fat. An equal amount of chuck and of plate meat are desirable. The navel end of the plate, or fore flank, contains excessive connective tissue and if possible should be excluded. Trimmings, rib covers and thin loins are not suited to the manufacture of a high grade article. Soft or excessive fat should be excluded. The inspection for quality of beef for canned corned beef for reserve rations is the same as given above.

Beef Tongues. Beef tongues for canning should be of good quality and in good condition. Mutilated tongues or pieces are excluded.

Tripe. This may consist of 10 per cent honey comb and 90 per cent plain tripe or otherwise as specified, of good quality, strictly fresh, properly scraped, clean and in good condition.

Trimming. Pork Products. *Army Bacon.* Bellies should be square cut and well trimmed. Defects include beveled, ragged or torn edges; not properly trimmed; not trimmed back of the teat line (sows); shoulder end too thick; flank end too thin; excess of fat back left on belly; bad lacerations, dugouts or deep tears from hooks; bones not removed; presence of shoulder meat; pizzle pouch or excess feather bones; and not properly scraped. Costal cartilages are firmly imbedded in the musculature and their complete removal may result in quite a loss of lean meat. Usually it is impossible to determine the presence or absence of red or black seeds and diseased conditions in the mammary substance of a sow belly unless incisions are made into each udder. As this would constitute a mutilation, for all practical

purposes sow bellies should be seedless, i.e., cut back of the teat line. Such trimming would result in the removal of a considerable amount of lean meat, therefore barrow bellies which require little trimming of the belly edge are more desirable.

Where scribe sawing is practiced an excess of fat back may remain on a belly thus lowering the percentage of lean. Extra short clears are not as desirable as clear bellies for the same reason. The "boot-jack" end of extra short clears should be squared up. Shoulder ends of bellies should be cut back far enough to eliminate any shoulder tissues which if included would become salty, dry, hard and tough during curing and smoking. The shoulder end should not be over 3 inches in thickness. Care should be taken to see that the thickness of shoulder ends is not reduced through excessive rolling, pounding or by removal with a knife. Flank ends and belly edges should not be less than 1 inch in thickness. Belly edges should not be beveled.

One veterinary authority states in effect that in the preparation of Army bacon, the veterinary inspector should watch the sorting of bellies or extra short clears from the cutting floor. This is the point to reject faulty trim, bruises, skimpy cuts, thin fat backs under 1 inch in thickness, and other defective bellies or extra short clears offered. No extras or bellies having black or red seeds should be accepted (the so-called pink or light seeds are classified as red seeds), unless the bellies are trimmed back so as to remove the seeds. White seeds are acceptable. Diagonal cutting to remove the seeds of extra clears is permitted, provided the edge left after cutting out seeds is 1 inch or over in thickness. It is also permissible to cut on a diagonal, having the shoulder end slightly wider than the other end, provided there are no jagged edges. As soon as an error is apparent, the attention of the cutting floor foreman should be called to the irregularity and steps taken to correct it. If the cutting floor foreman does not give the proper satisfaction, the matter should be taken up through the superintendent's office and adjusted there.

Pork, Salt. When backs have not been split medially, equal proportion of hard and soft backs may be specified cut into pieces about 5 or 6 inches in width.

Hams. Hams should be cut 2 inches from the aitch bone, shank cut off above the hock joint without exposing the marrow, closely faced, both cushion and flank sides cut close, butt ends well rounded and cut under producing a symmetrical contour. Hams should be well trimmed. The flare of the flank end should not be exaggerated,

but should not be cut square or cut under as the skin contracts during smoking and may produce an uneven appearance. The marrow of the shank should not be exposed as sourness may result. The pelvic (gut) fat should be removed as this fat may become rancid in smoke or storage. Hams should not be faced so as to remove the fascia covering the lean meat. Such hams may become pickle soaked, discolored, sour, off flavored and may dry out excessively during smoking.

Shoulders. Picnics should be well trimmed. Shoulders which have been "finaled" should not be used.

Beef Products. *Beef, Salt,* is cut into desirable sized pieces (see "2. Curing").

Meat Flour. Beef for the manufacture of meat flour should be free from all visible fat, ligaments, tendons and cartilages; bone; and all other white fibrous connective tissues, readily removable.

Corned Beef. After cattle are ribbed, the fore quarters are thrown on a table, shanks removed and rejected, shoulder clods pulled, the plate is removed from the back, the square cut chuck from the rib and the plates boned out. The fore flank may be rejected. The skirts are removed and rejected, the chucks boned out, the bloody end of the neck trimmed free from all blood clots and infiltrated tissues and the ribs boned out. The rib fingers (intercostal muscles) are used. They contain a large amount of undesirable tissue, but this can be removed after cooking on the canning floor. The hind quarter is put on a table, flanks removed and rejected. The loins and rump are removed and the hind shank is removed and rejected. The loins may be saved by the packer, or the kidneys and kidney fat removed and rejected and the tenderloin pulled. Light tenderloins, weighing less than 3½ pounds, called "strips" are usually used for Army goods and are acceptable. Rumps are boned out. Beef hams are divided into insides, knuckles and outsides. Outsides should have pieces of shank meat removed. Hanging tenderloins may sometimes be accepted.

All desirable cuts are carefully sorted on the boning benches, rejecting any sloppy, bruised, or other undesirable pieces. Accepted cuts are placed into clean, sanitary trucks and tagged "U. S. A." If necessary to transport the meat a long distance between the cutting floor and the pickle cellar, the trucks containing the fresh meat should be covered with clean tarpaulin while on the journey. When the meat arrives at the pickle cellar the tags are checked by the veterinarian who also removes them when the trucks have been emptied. The

veterinarian should note the quality of meat arriving in trucks to determine uninspected meats, also whether tags have been removed or switched. Meat intended for short cure, after sorting on the boning benches, may be cut into pieces about the size of the fist by being run through a set of rotary knives and then dropped through a chute directly into a leaching vat or tram truck.

Beef Tongues. Mutilated tongues are eliminated. Canner tongues are trimmed close with all bones, surplus fat, gross connective and other undesirable tissues removed. (The mucous covering is removed after cooking.)

Weight. Weight averages as required by contract specifications should be followed. Pieces should not be too heavy or too light. Sometimes the lighter averages are more desirable. Care should be taken to note if green or cured weights are specified. Veterinarians should become familiar with the percentage relation certain cuts bear to live and dressed weights of various types of food animals, also with trimming, boning, curing, smoking or other shrinkage or gain. Clear bellies represent about 12 per cent of the live weight of a swine. This is reduced to 10 per cent for trimmed sow bellies which are seedy. The weight of the cut specified should be shown on the bid, because sometimes the lighter averages, as hams, are more valuable to the trade. Averages may be as follows or otherwise as specified: clear bellies, 10 to 22 pounds cured; extra short clears, 20 to 50 pounds green; back pork pieces 4 to 6 pounds each; dry salt and sugar cured hams in 8/10, 10/12, 12/14 and 14/16 pound averages on delivery; picnic shoulders from 6 to 10 pounds when cured; beef, salt pieces averaging 8 to 10 pounds each; beef tongues about 30 ounces when delivered. A two-pound can containing a finished 30 ounce tongue and 2 ounces of soup stock, would require a rough tongue weighing from 6.7 to 7 pounds. The yield from rough to canner trim is figured as 52 per cent, and the yield from canner trim to canned weight considering loss due to curing, cooking and skinning, is about 54 per cent. Light weight tongues may be used where 6 pound cans are specified.

(b) Selection of Commercial, Cured Products. This includes breakfast bacon, sugar cured hams, corned beef, dried beef, and other cured products. Usually the best quality is desired, and the exact brand stated in each proposal and contract; otherwise; the second or third grade may be delivered.

Breakfast Bacon. This article is intended for domestic use and is usually commercially cured and commercially smoked. A veterinarian

should inspect and try each piece. Bacon selected should be of the best quality, sugar cured, from recently slaughtered swine in prime condition, showing marks of prior official inspection, sound, square cut, seedless, boneless, well trimmed and free from ragged tissues, thick rind, coarse muscle tissue or "dugouts" where bruises have been trimmed out. Bacon from boars, stags or old sows or which is oily, soft, extremely thin, seedy, rust discolored, sour, bruised, mouldy or otherwise unsound should not be accepted. All pieces having white spots due to having touched other pieces while in smoke should be rejected unless resmoked before being packed. (Also see selection of canned bacon, Chapter X.) The weight specified should govern. Usually this varies from 5 to 7 or even 9 pounds.

Sugar cured hams of the best quality should be from recently slaughtered animals in prime condition, sound and showing marks of prior official inspection, closely faced, plump, short, cushion and flank sides cut short, butt ends well rounded and cut under, fat not excessive in proportion to the weight of each ham (usually not to exceed 2 inches in thickness) and free from ragged tissues as pelvic fat, thick rind, coarse muscle fibre and exposed shank marrow. Hams from boars, stags, or old sows or those which are oily, soft, bruised, rust discolored, sour, mouldy, infested with skippers, beetles, or other insects, otherwise unsound or showing dugouts, should not be accepted. A thorough trier inspection should be given each piece. Care should be taken to see that hams with burnt out, sour marrow cavities are not accepted. These burnt out cavities have been on occasion filled with lard or salt to disguise the true condition. The weight of hams to be delivered should be specified on the bid because the lighter hams are more valuable to the trade. The weight specified should govern; usually the following ranges may be given: 10/12, 12/14, or 14/16 pounds.

Corned beef prepared from dressed carcasses of recently slaughtered animals in good condition, and cured with pure salt, saltpetre and sugar may be selected. (See Chapter X.)

Dried beef prepared from the best quality commercially cured dried beef sets may be selected. Insides and knuckles are more desirable than outsides. That prepared from shoulder clods or rump butts is not so desirable. The product should be thoroughly dry, sound and free from sourness and green areas or discolorations caused by hooks or triers.

(c) Selection for Other Manufacture. This includes pork for canned beans with pork, corned beef for corned beef hash, and others.

Pork and Beans. The pork which is used in pork and beans prepared for troops should be inspected by an Army veterinarian. Unsmoked dry salt pork as jowl and side pork, smoked dry salt pork, or sweet pickle pork in tierces, may be used. The pork selected should show marks of prior official inspection, should be wholesome, free from skipper infestation, and not slimy or otherwise unsound.

Corned Beef Hash. The corned beef selected for corned beef hash should be from strictly fresh beef, from cattle in prime condition. Flanks, skirts, bone, cartilage, tendons, fibrous, skinny and other gross connective tissue, soft and excessive fat, scrap meat and blood clots should be excluded. The best corned beef hash is made from long cured brisket beef. Briskets have a quantity of firm fat. More fat can be used in hash than in the regular corned beef. Where the long cure is used, more of a salt flavor is developed in the meat and seems desirable. All corned beef should be inspected when removed from the vat for soundness, cure and suitability. It should be well trimmed before using.

(3) Curing Inspection. (a) General. Inspection procedure for curing includes the sanitation of compartments and products involved; the selection of the products for soundness, condition, quality, trimming and weight in the cutting room, curing room or curing cellar; and their curing, overhauling and removal from cure. Meats to be placed into cure should be inspected to eliminate those unsound, and to see that inedible or rejected parts are removed. This would include an examination for "seedy" belly, parasitic conditions, mould, slime, abscesses, bruises, contaminations, hair, scurf, blood clots, sexual odors, icterus, deteriorations and decompositions.

Vats and boxes used in curing meats or manufacturing pickle should be scrubbed with hot water and steamed. Water used in making pickle should be pure and clean. Floor racks on which meats are laid down should be clean, and clean splash boards 3 feet high used on alleyways. The pumping needle and apparatus should be sanitary, pumping properly done and an examination made to see that unauthorized preservatives in pickles or cures are not used.

Fluids should not be permitted to drip into vats or onto meat. Rubbish or utensils should not be stored on meat. The pickle should be examined from time to time to determine its condition. If the pickle becomes ropy or sour, the meat should be washed, thoroughly tested, vats or boxes thoroughly cleansed, sterilized with steam, and new pickle used. Inspection should be made at overhauling. Any meat, if only slightly sour should be rejected.

All meats when removed from cure should be inspected for sours, slimy conditions, moulds and other deteriorations.

(b) Pork Products. *Army Bacon.* Fresh bellies and extra short clears should be placed into cure within a reasonable time after delivery to the cellar and should be handled in a careful and sanitary manner. They should be piled on racks until placed into cure and never piled on the floor. An allowance of 14 per cent for shrinkage should be made from the green to the delivered product, therefore a sufficient number of pieces should be laid down on each award to cover this shrinkage.

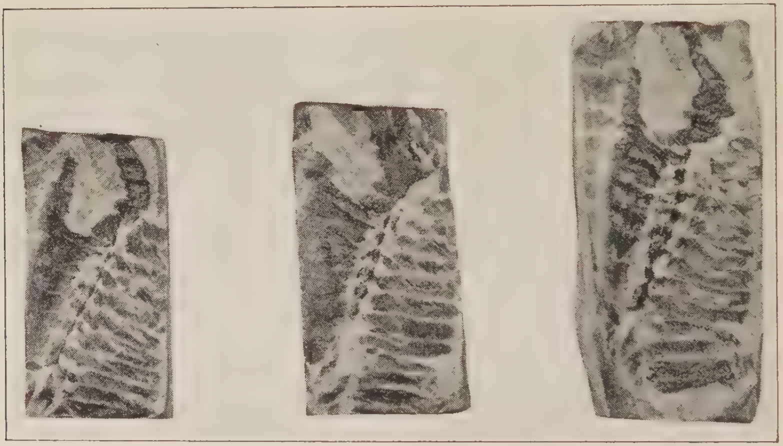
Dryness is essential in Army bacon, therefore moisture as pumping, application of water, brine or wet salt, covering piles with tarpaulin or similar material and piling directly on floors or against walls is not permitted.

Usually a dry salt mixture of clean, pure, dry vacuum pan or grainer salt, saltpetre and granulated sugar, as specified, is prepared by thorough mixing to insure uniform curing. Selected green bellies or extra short clears, as specified, are covered with a definite amount of this mixture, usually 6 pounds to 100 pounds of meat. A layer of salted bellies is then placed skin side down on clean floor racks, having 4 inches clearance from the floor to admit of perfect drainage, and which are covered with clean salt. Bellies are packed tightly against one another to prevent air contact. Successive layers of bellies covered with the curing mixture are then piled skin side down, to form a rectangular pile about 4½ feet high. The width, height and size of piles usually are specified. An alleyway should be maintained around each pile wide enough to permit of inspection.

The veterinarian should keep a permanent complete record of each lot cured including contract number, designation and location of official establishment, name of product, amount of contract, date of award; date due; date contract began (first put down); date finished curing; house lot number; location of lot, section, floor and tier; number of pieces placed into cure, average weight of pieces, total weight, dates placed into cure, dates overhauled, date removed from cure, name of veterinarian inspecting, remarks and signature. Record also should be kept of rejections, causes and amounts.

A cellar card inserted in each pile in cure should be used containing above data. Each card should be initialed by the inspecting veterinarian and when the curing is completed, all cards promptly furnished the responsible veterinarian for filing.

One veterinary authority states in effect, that all extras and bellies should be properly covered with the curing mixture, the veterinarian should not permit bellies or clears to be pumped or dipped into pickle before being placed into cure, when laid down products should be piled on racks to insure proper drainage and clean splash boards placed around the sides of piles to keep the meat clean, old boards, rubbish or utensils should not be placed on piles of meat in cure, all pieces that become contaminated or dirty by falling on the floor should be trimmed with a sharp knife, and that all Army extras and bellies in cure should be in separate piles from commercial products with a space of at least one foot between piles of Army and commercial goods.



(Permission United States Bureau of Agricultural Economics)

FIG. 50. CLEAR BELLIES
(For breakfast bacon)

The overhauling of bellies should not be delayed if possible to prevent it. The average time is seven to ten days and fifteen days should be the limit. The date of overhauling as specified should govern. At overhauling about 4 pounds of salt or dry salt mixture may be added to each 100 pounds of meat.

Army bellies and extra short clears may be cured twenty-five to forty-five days, depending on the weight of the bellies. Thorough curing is essential to preservation and each pile should be kept in cure until the heaviest piece in the lot is cured. Thirty days is sufficient to cure the average belly or extra short clear, and the bacon should be smoked as

soon after that period as possible. If it becomes necessary to hold the meat in the cellar for a longer period it will need to be carefully watched to prevent it from becoming slimy or purgy. After forty days in cure they should be overhauled a second time unless they are dry and still covered with salt. It should be borne in mind that these cuts contain a large percentage of lean meat and are likely to sour and should be smoked, if possible, before being sixty days old. In "old" dry salt meats, rancidity due to oxidation, and fatty acids due to hydrolysis may result with deterioration, strong flavors and yellow, rusty discolorations.

The average shrink during cure is about 2 to 3½ per cent.

One series of tests on Army bacon (bellies) gave the following: Amount of curing mixture used on initial lay down 5.49 to 6.88 per cent, average 6.1 per cent; amount of curing mixture used on overhauling 4.40 to 5.81 per cent, average 4.8 per cent; dry salt shrinkage 0.66 to 3.29 per cent, average 1.77 per cent.

Salt Pork. This product may or may not be cured in sweet or plain pickle before being packed. The quality is determined by the number of pieces to the barrel, 50 to 60 pieces usually has been the quality desired. As lighter pieces are of better quality the veterinarian should see that the proper proportion of light pieces is furnished.

Salt pork gains in weight in cure from 6 to 10 per cent, and to compensate for this increase a counter-weight of 4-pounds per hundred is placed upon the beam of the scale when the product is being weighed.

Good, new, fired and paraffine coated hardwood barrels or half barrels may be used (see specifications). A layer of capping salt, then a layer of meat may be placed into the package, another layer of salt, more meat and so on until the container is full, the top being covered with capping salt and the package headed. Later a quantity of 100° brine is added to completely fill the barrel which should be air tight to prevent leakage. (See specifications.) One specification required 15 pounds of the best capping salt and 6 ounces of pure, clean saltpetre to be placed at the end of each barrel.

During inspection care should be taken to see that the meat is properly drained, of proper quality and free from tag ends, improperly shaved pieces, bruises and blood clots. Unsound pieces should be rejected. The markings on the packages should conform to purchase requirements and those of the Surgeon General. To prevent the obliteration of these marks, a coat of varnish may be added as soon as the markings are dry.

Hams. Dry Salt Hams. The inspection procedures for Army bacon during curing generally are applicable for dry salt cured hams

for the Army. Each veterinarian should become familiar with all purchase requirements pertinent to curing. Usually the hams are piled on racks not to exceed 3 feet in height with shank ends sloping down. The hams may be pumped with a specified pickle solution at lay down usually not to exceed 2 per cent. The hams may be overhauled two times, and cured at least forty-five days, usually figuring five days per pound weight (averages).

Sweet Pickle Hams. The veterinarian should be governed by the purchase requirements in the curing inspection of sugar cured hams for the Army, care being given the sanitation, pickle and pumping solutions, pumping, overhauling, repumping and other processes and the complete sanitary requirements of the Surgeon General. Usually four days per pound weight (averages) in a full strength compound pickle is allowed in cure. Hams may be overhauled three or four times during the curing process.

Shoulders. Picnics may be selected from fresh sugar cured stock or otherwise as specified. In any event the veterinarian should be fully satisfied that the product selected is in compliance with all Army sanitary and purchase requirements.

(c) Beef Products. *Beef, Salt.* This product should comply with both the Army sanitary and purchase requirements. The remarks for Salt Pork are generally applicable for Beef, Salt, except the quality of the beef rather than the size of the pieces indicates the character of the product.

When mess or salt beef is packed in barrels a deduction is made for the brine contents. In determining the net weight of a barrel of salt beef, a sufficient number of barrels should be emptied, the contents allowed to drain and the net weight determined.

Meat Flour. The method of evaporation or desiccation as specified should govern. The vacuum method is the more desirable. Care should be taken that the meat is not cooked in the slightest degree or otherwise deteriorated, that the finished product is sufficiently low in moisture content, properly ground and bolted. The coarse fibrous tissue and that part which fails to go through the meshes should be rejected. (See specifications for "Emergency Rations.") In the event of any dispute, samples should be selected and forwarded to a Medical Department Laboratory in accordance with regulations.

Corned Beef. Usually corned beef for the Army is cured in accordance with the usual commercial practice. The veterinarian should require strict sanitary methods in its production and a well cured prod-

uct free from sourness and other unsoundnesses and undesirable features. Uniform sized pieces of meat should be used in order to obtain a uniform cure. The veterinarian should cut through some of the larger pieces after curing is said to be complete. Uncured centers will appear dark compared to the red color of cured areas. Uncured pieces should be excluded.

Each tierce or vat containing Army beef in long cure should be labeled "U. S. A." and numbered consecutively and tagged with a card showing the date put into cure, dates overhauled, date due, weight, and signature of the veterinarian. These tierces should be placed in rotation in separate rows and kept separate from any commercial beef in cure. The number of tierces filled each day including weights should be checked daily with the amount passed on the beef cutting floor and that received in the pickle cellar. The length of time required to properly cure beef depends upon the size of pieces and the strength of pickle, small pieces being cured in a shorter time than larger pieces. The time of cure varies, from eight to twenty, or even thirty days at 36 to 38°F.

After the meat is properly cured, which can be determined by cutting through some of the larger pieces and noting if the cure has penetrated to the center of the piece, it is removed from the tierces.

When the cured meat is removed from the tierces or vats, the tags are removed and filed, and the meat is placed into clean trucks labeled, "U. S. A." The veterinarian should keep record of the number of tierces or vats emptied each day and the weights. The meat is then sent to the cooking room.

The handling of short cured corned beef is practically the same on the cutting floor as the regular long cure. At some establishments the beef used for short cure is cut into smaller pieces than for the long cure. The trucks or buckets containing the fresh beef to be used for short cure should be tagged same as for the long cure. The meat is usually taken to the cook room and cooked under steam for about thirty to sixty minutes. The cookers should bear the Army tag. Meat is then removed from the cooker while still hot and placed into tierces or other containers where hot pickle is poured onto the hot meat. These tierces should bear the Army tag. The meat in tierces is stirred at frequent intervals to allow all pieces to come into contact with the pickle. Usually after eight to twelve hours' time the meat is cured. It is then taken to cooker and given a short cook, of five to fifteen minutes before it is sent to the trimming room. In short cured corned

beef a few very small gray centers, if not excessive, may be allowed to pass, as the curing process continues after the meat has been canned.

Particular attention should be paid to the condition of pickle used in short cure, as it frequently becomes sour. If pickle becomes sour the meat immediately should be removed, washed off and fresh sweet pickle put on the meat.

Beef or Ox Tongues. These are usually cured in pickle by the long cure method with a small amount of shrinkage. To determine if tongues are thoroughly cured, the veterinarian should make a medial incision in the ventral surface of the root of certain selected large tongues in cure. This incision is made in the thickest part of the tongue about 2 inches in length and to the center of the tongue in depth. Under-cured tongues will show an uncured "grey line" in the interior. By making an inspection incision in this manner a tongue will not be mutilated or rendered unfit for canning purposes.

Tripe, Pickled. The curing of tripe for the Army should be in compliance with both the sanitary requirements of the Surgeon General and the purchase specifications.

(4) Smoking Inspection. (a) General. Inspection Procedure for Smoking: Meats going into smoke should be sound and free from slime. They should not be soaked to remove salt, but may be brushed, or washed quickly and allowed to dry. Soda ash or caustic soda should not be used in washing. Hams with exposed shank marrow and intended for the Army should be excluded, if possible, at this time. Meats should be properly spaced in the smoke house, hanging free from the walls and from each other. Wherever pieces touch, a white spot after smoking results which may give future trouble. Inspections should be made at the smoke house as often as necessary to see that a proper temperature and a sufficient amount of smoke are maintained in accordance with current specifications or requirements.

After coming out of smoke, meats should be cooled to room temperature and tried, and again inspected before packing. The hanging room should be screened, free from flies, dry and not musty.

(b) Pork Products. *Army Bacon.* After curing and before smoking, bellies and extras may be washed, or preferably brushed with a broom, to remove all loose or surface salt. Soaking is not desirable. Meat covered with surface salt does not take the smoke well.

Brushing instead of washing is preferable as bacon for the Army should be kept as free from moisture as possible. Pieces should be

swept thoroughly on the skin side or back, the flesh side or face and all edges, using an ordinary corn broom not too stiff and hard, and not too flexible and soft. The veterinarian should see that all bacon is thoroughly swept as this process requires considerable effort and attention on the part of the workmen.

The washing of cured meats should be as thorough as possible, without soaking. A tub of luke warm water and a scrubbing brush to remove the adherent salt will admit of the bacon being handled properly. The use of a washing machine in which the bacon is sprayed is a good method, as the bacon is not allowed to soak. The pieces may be placed flat, skin side down on a moving table, passed under a spray of hot water, turned skin side up, passed under a second spray of hot water, then passed under jets of compressed air which blow the excess moisture from the meat, scraped with hand scrapers, branded with the required inspection legends, strung and hung on trees. Upon coming out of smoke, brushed bellies and extras will show more surface salt than those which have been washed.

Army bellies have two short strings inserted either through the flank or the shoulder end by means of a needle, about 2 to 3 inches from the end and about 3 inches from the edges. (See Hanging under Commercial Smoking.) The ends of the strings are tied so as to form a loop by which the bellies may be suspended from smoke sticks or smoke trees.

Each cured extra short clear after washing or brushing is divided into two approximately equal pieces, being cut through on a line perpendicular to the edge of the back. Each piece then has two strings inserted in the belly edge. Should this division be made after smoking it would leave a raw unsmoked edge liable to become mouldy and sour if stored for any length of time.

Smoke houses and smoking equipment as trees, screen trays and smoke sticks should be thoroughly cleaned before using, otherwise contamination of meats with combustion products may result. Smoke houses may be cleaned by means of steam and a weak solution of hydrochloric acid; and smoke sticks, trays and trees in a washing apparatus or scrubbed by hand. Bellies and extras are hung on the arms of trees or on smoke sticks in such a manner that they do not contact each other. Tree arms should be far enough apart to prevent contact. Whenever pieces touch in the smoke house, a soft white spot remains after smoke and is liable to give future trouble.

After washing, the bacon should be drained well before being placed into the smoke house, to prevent dripping from the upper floors. Cold,

cured meats coming from a curing cellar and hung in a warm room become moist through condensation of atmospheric moisture. Thus loaded trees should be run into the top floor of the smoke house first, and the lower compartments filled successively, otherwise drippings will pass through the unclean gratings and contaminate and stain meats hung below.

Usually one day at least is allowed for the hung bacon to dry out in the smoke house before the smoke is put on.

The veterinarian should see that a registered, standard thermometer is provided for each smoke house. Each smoke house should be tagged as follows: Purchase order number, designation of establishment, name of product, lot number, floor, location, number of pieces, number of pounds, date hung, date smoke is started, date smoke is discontinued, date ready for packing, smoke house temperatures as recorded at different intervals, remarks and the name of veterinarian actually doing the inspection. These cards should be kept in the veterinarian's permanent station file after smoking is completed.

Army bacon is usually thoroughly and continuously smoked seven to nine days in a cool smoke produced from hardwood or hardwood sawdust, the idea being to use the sawdust only when, in the opinion of the inspector, the heat is too great for the quantity of smoke produced; that is, there comes a time after the wood has burned out when only a bed of hot coals is left, and hardwood sawdust dashed over these coals will reduce the heat and increase the smoke. It is recommended, however, that sawdust be not used unless necessary as bacon becomes too dark in color where continuous smoking with sawdust is employed, due to too much smoke. As gas is not permitted to produce the heat, hardwood is used.

The temperature of the smoke house should be maintained at about 110°F. It will, of course, be impossible to maintain this temperature uniformly, but it should not go below 100° and preferably not above 110°.

High temperatures cannot be employed in smoking meats seven to nine days, due to liquefaction and dripping of fats, however, a sufficient amount of moisture would not be extracted at a temperature lower than 100°. At first a temperature of 125°F. may be maintained until the products are warmed through, then reduced gradually to 115°F. or lower. Throughout the smoking operation bellies and extras should remain warmed through but not wet with grease, to obtain the desired results. The higher the temperature the more shrink will result.

During summer conditions bacon may be sufficiently shrunken and desiccated in seven days' smoke while the maximum of nine days may be required in colder weather.

Inspection should be maintained at these smoke houses as often as may be necessary to see that the temperature is being maintained and that a sufficient quantity of smoke is produced to properly smoke the bacon. The purpose of smoking bacon is to obtain the preservative effect of the creosote contained therein, and to that end care should be taken not to hang the pieces so closely together that they touch. Whenever pieces touch in the smoke house a soft white spot results which is likely to give trouble in the future. Pieces bearing these spots should be rejected before packing and returned to the smoke house for additional smoking.

After smoking is complete, the fires are permitted to die out and the doors and ventilators opened. A sufficient time should be allowed to thoroughly color the product, which is hastened somewhat by removal from the house as soon as the smoking is completed; this for the reason that the hot walls prevent the bacon from cooling. Otherwise the bacon may be allowed to remain in the smoke house until quite cool. Smoked bacon should not be subjected to humid, foggy, rainy or other adverse climatic conditions. Before being delivered to the packing floor what loose salt has accumulated on the surface of the bacon during the process of smoking should be removed with a dry brush, preferably a broom. It should be delivered to the packing floor in hot weather only as fast as it can be handled advantageously.

Army bacon will average 9 to 12 per cent shrinkage from cured to smoked weight in an eight day smoke. One test on Army bellies gave a smoking shrinkage from 8.29 to 11.16 per cent with an average of 10.1 per cent, and a total shrinkage from green to smoke weight of 10.29 to 13.42 per cent with an average of 11.6 per cent.

Hams. Dry salt hams are freed from salt by thorough brushing, hung one day before smoking, smoked at least six days preferably in dry smoke from hickory or rock wood maple, then hung to cool before being packed. These hams shrink 13 to 15 per cent from green to smoked weight.

Sweet pickle hams for the Army are washed, hung one day, smoked in dry, cool smoke from dry hardwood or hardwood and hardwood sawdust six to eight days then cooled for packing. These hams shrink 6 to 8 per cent from green to smoked weight.

Shoulders are thoroughly washed (not soaked) before smoking, then continuously and thoroughly smoked in dry cool smoke from dry hardwood or hardwood and hardwood sawdust for at least six consecutive days, or, otherwise as specified.

(5) Packing Inspection. (a) General. Packing inspection of cured meats includes the sanitary handling, inspection, weighing, wrapping, tying, labeling, or other manipulation, packing into various containers and marking of the same. The specification or other purchase requirements should be followed as well as the sanitary requirements of the Surgeon General.

(b) Pork Products. *Army Bacon.* Army bacon may be wrapped and packed into crates, cut into pieces or slices and canned, or otherwise packed as specified.

After smoking the bacon should be cooled, placed upon a clean table or rack and both sides and edges thoroughly brushed with a clean broom or brush to remove all surface or loose salt. If piled on a table or truck before brushing the surface salt is forced into the fat and is difficult to remove. Long filaments of salt crystals in the region of the cut ends of costal cartilages should not be mistaken for mold. Pieces are freed from all skewers and strings, wiped dry, then given a thorough inspection before wrapping. If to be canned, the pieces are square cut, freed from ragged edges and otherwise well trimmed before cutting or slicing (see Chapter X).

A trier inspection should be given each belly especially along the line of rib attachments and in the string holes. This trier inspection should be thoroughly supervised. All sour or bruised bellies or those showing subcutaneous hemorrhages or soft, uncolored areas should be rejected. Soft, uncolored areas may result from contact in the smoke house, or when brushing or washing has been done carelessly prior to smoking. If such bellies are scraped, placed in the smoke house and properly resmoked and become firm, they may be accepted. The Army veterinarian should try to avoid final rejection of bruised, seedy or other objectionable bellies after smoking, which could and should be rejected in the pork cutting room or during the curing process. Close watch should be made for skippers. Skipper infested bacon should be rejected and smoke houses and hanging rooms cleaned up and properly screened. Weights should be carefully checked and scales frequently tested.

When wrapped in 2 sheets of paraffine paper and one sheet of heavy absorbent paper between, the innermost sheet is closely wrapped about

the piece and then the other two wrapped about it and securely tied with strong twine. The wrapping should be carefully done so as not to tear the paper. The purpose of the paper is to protect the bacon from insects and dirt. A small hole is often worse than a large one for the reason that its presence may not be suspected until insects have taken possession of the piece. There are many grades and kinds of absorbent and paraffine paper used. Brittle paper which may crack when folded over the corners of bellies should not be used. The paper should be clean and sanitary. The innermost wrapping retains any fat or oil which may be rendered from the product during warm storage and excludes moisture. The absorbent covering also further prevents diffusion of grease or of moisture.

As a further protection against wear and tear of the coverings and to prevent insect infestation, for foreign or tropical shipment, bellies may be closely covered with a good quality of sheeting (as not more than 4 yards to a pound) or strong muslin, securely sewed.

The boxes or crates should conform to specifications, and the conditions outlined in the purchase order should be carefully followed. Attention should be given the marks on boxes and cases to convey the information required. Bacon is usually packed in slatted crates to insure some air circulation. The crates are rectangular and may contain 100 to 125 pounds of bellies. Wire bound veneer crates while lighter are difficult to handle and to pile because of loose wire ends, and are not as stable or desirable as wooden crates. For warm climates the slatted crates may be lined on the inside with a durable fine meshed screen to exclude skipper flies. Usually cement coated wire nails are used in the construction of bacon crates as uncoated nails do not hold so well. Straps should be drawn tight about the end of each crate and securely nailed. Wires when used are placed about one-quarter way in from the ends, stretched tight, twisted and the loose ends cut off and turned under to facilitate handling.

All pieces, wrappings and crates, whether for domestic or export shipment, should be marked or labeled in accordance with the requirements of the Surgeon General, the purchase specifications and in compliance with those of the United States Bureau of Animal Industry or other interested official agency.

Weights should be carefully checked and recorded.

Commercial Breakfast Bacon. The commercial wrapping and packing boxes, crates or other suitable containers of about 100 pounds net, may be prescribed; or a special procedure as unwrapped, or wrapped

and packed in new airtight hardwood half-barrels about 90 pounds net. Bacon may be sliced and canned (see Chapter X).

Usually commercially cured and commercially smoked bacon is selected upon a piece, trier inspection. Sour, bruised, seedy, underweight, overweight, and extremely thin pieces should be rejected, also such as have had bruises trimmed out or showing white spots.

FIG. 51. PORK SHOULDER
(Showing position of bones)

A, Shoulder Butt; *B*, Picnic Shoulder or Cala; *AB*, Shoulder.
a, Scapula or Blade Bone; *b*, Humerus or Knuckle Bone; *c*, Ulna; *d*, Radius; *cd*, Shank Bones.

Hams. All hams should be cooled, freed from all surface or loose salt by brushing, thoroughly dried, freed from all strings or skewers, and tried along the shank bone, in the stifle joint, along the femur, under the aitch bone into the region of the hip joint, in the shaft of the ileum and in any exposed marrow cavity in the shank, before weighing, wrapping, or packing. Enlarged stifle joints first offer resistance to a trier, then a ready penetration. All burnt out stock, or hams with rancid "gut" fat, bruises, soft white spots, sourness in any part, hook holes, tears, stains, discolorations, skippers or other un-

soundness; over weight, under weight, too fat or otherwise not up to specifications, should be rejected. The rejected hams should be placed to one side until the veterinarian has finished inspecting the entire lot and thus prevent running the same hams through a second time. Hams may be delivered unwrapped, or wrapped, packed and marked in accordance with all sanitary and purchase requirements, which should be consulted.

Barrels, half barrels and quarter barrels when specified should be entirely new, substantial, dry and in the best possible shipping order. Dry salt may be sprinkled in the bottom of each barrel to a depth of 4 or 5 inches, the hams packed into the barrel and salt sprinkled in to fill all spaces between the hams. Barrels should be shaken while the salt is being filled in so the same will get in between the hams. The use of wet salt is not permitted in packing.

After packing, hams should be shipped as soon as possible as they mould readily.

Shoulders. Picnics should be inspected along the same general lines as hams, each piece being thoroughly tried; and handled, wrapped, packed and marked according to sanitary and purchase requirements, which should be consulted.

(c) Beef Products. The inspection, handling, wrapping or other manipulation, packing and marking of beef products as salt beef, meat flour, corned beef, dried beef, ox tongue, tripe and other commodities, should be in accordance with sanitary and purchase requirements which should be consulted (also see Chapter X for canning general and for corned beef, dried beef, ox tongue or other canned cured meats).

c. *Inspections on Receipt.* This is conducted whenever or wherever cured meats are accepted along the same general lines as outlined under Chapter VIII, "Fresh Meats." All cured meats should be given at least a 10 per cent sanitary veterinary inspection on receipt. If any deficiency in regard to unsoundness is discovered, the entire pack or shipment should be given both a superficial and deep examination. This inspection may include such reëxaminations for quality, quantity, wrappings, containers and markings as required by purchasing officers at time of delivery before final acceptance.

A surface examination would include an inspection for official inspection stamp, bruises, mould, insects, arachnids, fly blows, skippers and other unsoundness or undesirable conditions.

In examining smoked products for sourness or rancidity, a thin steel "trier" or tester should be introduced along the bones, into the

bone marrow and in the thicker portion of each product, along the line of rib attachment and where strings have been tied. Immediately upon removal the odor of the trier, should be noted. Decomposition frequently appears first in the bone marrow, or in the connective tissue adjacent to bones. The body of hams is also a favorite place for the development of this condition. Bacon may become "spot sour," that is, small areas may undergo souring. In the inspection of hams the trier should be inserted along the shank bones, into the stifle joint, along the femur, under the aitch bone into the region of

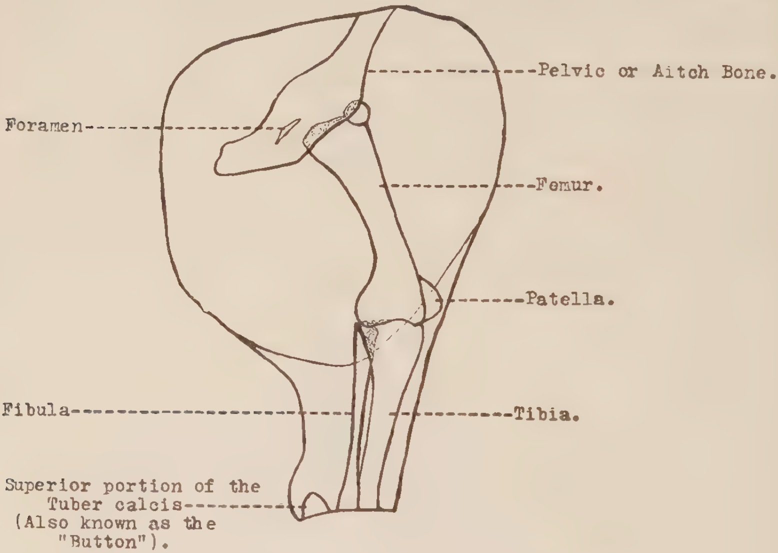


FIG. 52. REGULAR, AMERICAN, SHORT-CUT HAM
(Showing position of bones)
(Diagrammatic)

the hip joint, into the marrow canal of the shaft of the ileum and into the marrow of the shank, if exposed. (Also see Selection of Commercial, Cured Products.)

d. Inspections during Storage. The inspection of cured meats in storage is along the same general lines, where applicable, as outlined for fresh meats (Chapter VIII).

A well-ventilated, dry storage room at 40 to 50°F. is the most suitable place for storing cured meats, especially in warm, moist weather. Damp or wet coolers favor the growth of mould. If dry cold-storage

is not available, the meat should be stored in a dry, well-ventilated room. Crates containing Army bacon and dry-cured hams should be stored in such a manner as to favor a free circulation of air around them, while each piece of breakfast bacon, and sugar-cured hams should be hung up separately with space between. The room should be screened with screening of sufficiently fine mesh to exclude skipper flies, and the doors fitted with an automatic closing device.

Breakfast bacon and sugar-cured hams do not keep as well as Army bacon and dry cured hams, hence should be kept under close observation, especially in warm, moist weather, and they should receive a closer inspection. At posts and camps it is advisable that they be ordered in such quantities that they will be consumed within a month after receipt.

Crate bacon may shrink 1 to 3 per cent in storage due to loss of moisture, of fat absorbed by wrappings and of loosening of encrusted, surface salt. This loss is influenced by length of time in storage, humidity, temperature and handling.

Fresh pork may contain a trace of free fatty acid, cured Army bacon before smoking 0.65 per cent, after two days' smoke 1.7 per cent, after four days' smoke 2.5 per cent, after six days' smoke 2.54 per cent and after eight days' smoke 2.63 per cent. At the end of one year's storage, crate bacon may contain from 10 to 15 per cent free fatty acids. A tentative standard of 5 per cent has been adopted by certain health authorities as the maximum amount of free fatty acids, cured meats may contain and remain edible. One authority states that fats are looked on with suspicion when containing more than $1\frac{1}{2}$ per cent of acidity and are unfit for food where there is also a marked rancid flavor and odor. Another authority states that Army bacon may contain more than 8 per cent of free fatty acid without being rancid, but considers that any product in which hydrolysis has proceeded to such an extent as to give 8 per cent of free fatty acid, as unfit for food. High temperatures and moisture are conducive to hydrolysis, while at low temperatures and a dry atmosphere it is retarded.

The veterinarian should differentiate between a salt flavor, an old and sharp flavor, rancidity due to oxidation, acidity, sourness, and other fermentative or decomposition changes. It is stated that soft, mushy hams are due to sarcosporidiosis.

e. Inspections at Issue. A piece inspection should be given cured meats at issue (see "Inspection at Issue," Chapter VIII).

f. Action. This in general is the same as outlined under "h. Action," Chapter VIII.

A slight, superficial growth of mould on cured meats in the possession of a quartermaster, may be removed by wiping with a cloth; if more extensive, by washing with a mixture of salt, vinegar and water. After the latter treatment each piece should be wiped dry, and, if possible, subjected to a light smoke. If the growth of mould extends beneath the surface, the product is likely to have a mouldy flavor and therefore should be rejected. One lot of 24,000 pounds of breakfast bacon and sugar-cured hams were reprocessed by removal of the wrappings, scrubbing with 2 changes of warm concentrated brine, hung to dry out twenty-four to thirty-six hours, and smoked with hardwood chips thirty-six hours. A shrinkage of 10 per cent resulted.

When "skippers" are present, the product should be rejected unless all the larvae can be removed by trimming, as determined by a very careful examination, since the larvae have a tendency to burrow deeply into the tissues. In handling "skippers" meat due regard must be had for the wonderful leaping ability of the larvae, otherwise the infestation will spread to other pieces of meat. When meat is to be trimmed, it is a good plan to place it in ice-water for a short period, to render the larvae inactive. Infested meat should be rejected outright, and recommended burned or immersed in boiling water to destroy the larvae.

When insects or arachnids, such as the ham-beetle, larder beetle or ham mite, or fly blows are present, their removal and the trimming away of affected portions should be recommended. Meat soiled by excreta of cock-roaches is characterized by a nauseous roach-like odor, which renders it repulsive and therefore should be considered unsuitable.

All marrow and deep body sours or off flavors, also hams having had marrow burned out should be rejected. If small areas affected are present, their removal by trimming should be recommended and the remainder passed for food, but if a greater portion of a piece is affected the whole piece should be rejected. Mutilated hams or those having large, deep tears should be rejected, as these tears readily sour and become mouldy.

CHAPTER X

Products Inspection (continued)

D. CANNED MEATS

1. General. Canned meats are those hermetically sealed in metal or glass containers, usually with subsequent heat sterilization, for the purpose of sanitary preservation and to protect them for future use. Two meat products, namely, sliced bacon and sliced dried beef may be canned without sterilization, the can acting as a sanitary covering, the vacuum produced inhibiting microbial growth and the hermetical sealing of the container preventing entrance of air. Where lack of storage facilitates or where other conditions exist which preclude the use of fresh meats, canned meats may be relied upon to furnish the chief source of meat supply. As discussed in this section, canned meats, generally, include cuts, trimmings, offal or other parts of beef, pork, veal and mutton. Special attention is given canned meats prepared for the use of troops as fresh roast beef, corned beef, corned beef hash, sliced dried beef, meat flour, ox tongue, Army bacon, commercial bacon, pork and beans, deviled ham, fresh pork sausage, Vienna style sausage, veal loaf and meat soups. Canned, fish, poultry, eggs, and rendered, dairy and miscellaneous products are discussed under separate chapters.

2. Commercial Canning. In the manufacture of canned meats there should be considered the sanitation of the compartments involved, equipment, methods and personnel; adequacy of equipment; the source and purity of all products and ingredients used; systematic and uniform methods; the sanitary handling, cutting, boning, soaking, pickling, curing, cooking, drying, trimming, slicing, sorting or other preparation of materials used; manufacture and addition of soup stock; type, construction, size and cleanliness of cans, their stuffing, weighing, sealing, exhaustion, sterilization, chilling, inspection for defects, caustic bath, rinsing, lacquering, labeling and development. Certain meats as roast beef, corned beef, sliced dried beef and ox tongue generally are prepared the same while for others, considerable variation exists.

a. Preparation of Ingredients. (1) Meats. Meats for canning may be fresh, cooked or cured, in pieces, in the form of sausage or liquid,

with or without the addition of water, soup stock, vegetables, spices, milk, oils or salt and with or without the use of liners.

Meats intended for canning purposes should be from an approved source, bearing the inspection legend of an approved official and competent sanitary inspection agency, having been properly chilled, handled and stored or otherwise prepared and at time of canning, sound and wholesome. Usually these meats are hand trimmed and separated into grades on the cutting floor. (See Beef Trimmings, Chapter VIII.)

When fresh chilled meats are canned without parboiling, a large amount of free liquor (about 30 to 40 per cent) is extracted from the meat during heat sterilization. The sterilization of products canned by this method is said to be more difficult than where the meat is first shrunken by cooking. The product will have a better flavor than if parboiled due to the retention of meat juices and extractives in the can, but is moist and not sufficiently firm for slicing purposes. The amount of moisture which is transported with the meat is another objection. Fresh beef and fresh pork sausage may be canned without first parboiling.

In order that a firm dry product may be produced in canning fresh or cured meats without an excess of free liquor in the can, such may have their natural moisture content first reduced by parboiling in vats or kettles, in water heated by means of steam. The time required to shrink meats depends on the kind of meat, maturity, sex, quality, size of pieces and temperature of cooking, but is generally from five to thirty minutes, and may extend to two and one-half hours for some products such as beef tongues. Fresh or corned beef parboiled twelve to thirty minutes may shrink 30 to 40 per cent, pork tongues 34 per cent while beef tongues cooked one and one-half hours may shrink 32 per cent. Within practicable limits, the greater the time meats are cooked the greater the shrinkage. Provided meats are allowed to soak in the meat juices after parboiling, shrinkage is reduced.

No salt is added to meats when cooking.

In order to produce a better colored product in the cans, fresh chilled meats may be soaked in vats of ice water twenty-four to thirty-six hours before being delivered to the cooking room. (Also see "Beef Trimmings," Chapter VIII.)

Soaking and cooking waters containing meat juices and extractives may be utilized in meat extracts. (See Chapter XIII.)

Frozen meat for canning purposes may be placed into water at 70°F. and held in a cooler about forty-eight hours. After being in the water

thirty hours the meat should be separated into smaller pieces. When frozen meat is parboiled the regular length of time, while the outside portions will be sufficiently cooked the inside of the pieces may receive a temperature of not more than 100°F. This may cause the meat to become "gassy" before being placed into the cans. This condition further increases as about one hour's time is consumed between the the cooking kettle and the time when the sealed cans are placed into the sterilizing retorts. This gaseous condition may be overcome materially by exhausting cans with open vents in retorts. Provided such cans are exhausted in vacuo, the gassy cans may become swellers in from two to ten days.

After meats have been parboiled they are taken to the trimming tables where inedible parts, bones, cartilages, tendons, ligaments and other gross tissues and surplus fat are removed. In some instances the meat may be placed on a revolving table where circular knives set about 1 inch apart cut it into small strips or pieces; rocker choppers may be employed and vegetables and spices added to the product; tongues may be skinned of mucosae, and re-sorting and a sanitary inspection take place or other manipulation as later described.

Fresh, cured, smoked or cooked sausages, in bulk or stuffed into casings, may be canned.

(2) Soup Stock. According to the kind of product and the amount of shrinkage due to parboiling, or other factors, canned meats may or may not have soup stock added. Parboiled meats with only a moderate amount of shrinkage may contain sufficient moisture so that soup stock is not required. Dry meats, or those which are packed into cans in such a manner as to allow interstices or spaces to remain between the pieces of meat, may have soup stock added.

During sterilization, the penetration of heat throughout the meat stuffed into a can, is dependent entirely upon the ease with which convection currents are set up. Movement of heat occurs most rapidly where there is a free circulation of some liquid as soup stock between the solid pieces of meat in a can. Heat penetration is less rapid in dry packed products.

Soup stock or meat jelly for canned beef should be made from beef products. If products from other animals, as pork skins, are used in its preparation, their use should be indicated on the can label. One soup stock used, was prepared by cooking 700 pounds of fresh cattle bones, 12 pounds of salt and 100 gallons of pure water to such a consistency that after chilling in the can it would solidify to a jelly. For canned, cured pork products a soup stock may be produced by cooking

together 50 pounds of fresh pork skins and a barrel of water. For canned fresh pork products, an addition to the above is made of 40 pounds of salt. Calf's feet jelly is prohibited for use as soup stock by some sanitary regulations.

Only newly and properly prepared, sound soup stock should be used. Commercially, an establishment may use salt and water, or just water, instead of soup stock in canning certain products.

One very desirable soup stock used by a packer during the World's War for canned roast beef, was that prepared by concentrating the fluid from the vat in which the meat was cooked, and adding it back to the product in the cans. The finished product in this instance represented the original meat with the loss only of a certain amount of moisture.

(3) Milk. Milk added to tripe or other canned meats should comply with all sanitary requirements. (See Chapter XVII.)

(4) Water. (See "Manufacture of Ice," Chapter VIII.)

(5) Oils. Any approved and sound, edible animal or vegetable oil may be used in the canning of sausages. When necessary, Army veterinarians should collect samples of fully prepared oils and forward such to a Medical Department laboratory in accordance with Army Regulations.

(6) Salt. (See "1. General," Chapter IX.) Salt may be added to cans of fresh meats, as roast beef, at time of stuffing.

(7) Vegetables. Sound fresh or desiccated vegetables may be used commercially in the preparation of canned meats.

(8) Liners. For certain products it is desirable to keep the meat from actual contact with the metal of the cans or tops by means of paper or parchment liners, as otherwise sulfur from the product may form sulfide with the tin or iron and cause discolorations of the product and the metal of the can.

b. Preparation of Cans. (1) Tin Containers. (a) Manufacture of Tin Plate. In the manufacture of tin plate, one-half inch Bessemer or open hearth bar steel, 8 to 10 inches wide is cut into short widths according to the width of the tin plate to be produced. These pieces are heated in furnaces, then rolled, re-heated again, rolled, being folded over or doubled in the rolling process without welding until each pack contains about 8 layers of the desired thickness. The pack is then sheared free of double and rough edges and into desired sizes of rough black plates, which are separated, immersed in weak sulfuric acid to remove the surface scale or iron oxide, washed free from acid, then softened or annealed by packing the black plates in iron boxes which

are sealed tight with sand and kept at a red heat for eight to ten hours. After cooling, the plates are "cold" rolled with smooth rolls to produce a smooth, polished surface. The plates are re-annealed, cooled, re-pickled in an acid bath if necessary and stored in tanks of clear water until tinned.

The smooth, finished, soft, black plates are tinned by dipping them into a zinc chloride solution, then into molten tin, after which they are passed through rolls revolving in palm oil to remove the excess tin, the oil removed from the tin plate by means of bran, and the tin plate polished by rollers covered with sheep skin. The tin used for coating should not contain more than 1 per cent of lead. Terne plate, used for building purposes is not desirable for the manufacture of cans. Terne plate is manufactured in a similar manner to the tin plate used for canning, but contains about 2 parts of tin to 1 of lead.

(b) Tin Plate Standards. Tin plate for canning purposes usually is sold in sheets 14 by 20 with 112 sheets to a base box. Quotations may be on the basis of one hundred weight of tin plate having a square surface of 31,260 square inches. When tin plate weighs 95 pounds per base box it is quoted as light, 100 pounds ICL, 107 pounds IC, 128 pounds IXL, 135 pounds IX, 156 pounds IXX and 176 pounds IXXX.

For quality, tin plate containing about $1\frac{3}{4}$ to 3 pounds of tin per base box is known as coke tin-plate; 3 pounds, 1 A charcoal; $3\frac{1}{2}$ pounds, 2 A charcoal; 4 pounds, 3 A charcoal; 5 pounds, 4 A charcoal; and 6 pounds, 5 A charcoal.

Tin plate also may be designated according to the character of the annealing and the gauge. It is practically impossible to produce all sheets of tin plate of an exact thickness or with a certain, uniform coating of tin.

(c) Styles of Cans. *Packers' Cans.* Usually these are the "hole and cap" cans with all seams soldered and a hole in the top through which meat is stuffed into the can. This hole varies in size. Large pieces of meat, as ox tongues require a larger opening (about $3\frac{1}{2}$ inches in diameter) while smaller pieces of meat as corned beef may be filled into a can through a smaller opening. After stuffing, the hole in a can is sealed with a solder-hemmed cap by means of heat. After the can is exhausted the small vent hole in the center of the cap may be sealed (tipped) with a drop of solder. The vent hole may be protected on the inner surface by means of a small piece of corrugated tin or cleat held in place by solder. This cleat is used to prevent any of the product closing the vent while exhausting. An exception to the hole

and cap solder cans are those used for Army bacon and sliced dried beef. Packers cans may be round or square. Usually corned beef is packed in a square can which is pyramidal in form. Where large cans, or long sterilization at high temperatures are employed, packers cans generally are used. Key opening bands increase the danger of leaks. A patented type of key opening can has a "herringbone" type of scoring consisting of 3 longitudinal grooves with lateral grooves extending diagonally from the middle to outside grooves.

Sanitary Cans. The open top or sanitary can has replaced in many instances the solder can. The ends are stamped out of tin plate, and edged with rubber or composition, which is dried. Body blanks are stamped out of tin plate, and passed through machines which complete the body. The side seams may be locked and lapped, or lapped, and soldered. The bottom is attached or crimped on by means of a double seamer. Automatic air testing machines may be used to eliminate defective cans. Sanitary cans usually are round and are useful where small cans are desired, as up to two pounds weight, or where lower processing temperatures are required, as for cured meats. After filling the can, the top is crimped or double seamed on, mechanically.

Usually the ends are made from heavier tin plate. For meat canning, heavier tin plate is required in the construction of cans than that used in the canning of vegetables. Some can manufacturers guarantee to replace or be responsible for the loss of goods packed in cans which show more than 5 per thousand defective due to faulty manufacture. This would exclude top leaks due to faulty crimping at an establishment.

(d) Sizes. While there are a great many sizes and shapes of cans, the following are known as common, standard sizes.

NUMBER OF CANS	DIAMETER	HEIGHT	CAPACITY
	inches	*inches*	*ounces*
1	$2\frac{11}{16}$	4	11.6
1 (tall)	$2\frac{11}{16}$	$4\frac{1}{4}$	12.3
2	$2\frac{3}{8}$	$4\frac{9}{16}$	21.3
$2\frac{1}{2}$	4	$4\frac{3}{4}$	31.2
3	$4\frac{1}{4}$	$4\frac{7}{8}$	35.0
3	$4\frac{1}{4}$	5	35.5
3 (tall)	$4\frac{1}{4}$	$5\frac{1}{2}$	39.0
8	$6\frac{3}{16}$	$6\frac{7}{8}$	104.0
10	$6\frac{3}{16}$	7	107.0

(e) Cleanliness. Before stuffing, all meat cans should be thoroughly cleaned by washing in hot water, sterilized by steam, drained and inspected. In packers' cans care should be exercised to see that the cans are free from flux on the inside at the top and bottom seams.

(2) Glass Containers. These include many forms of jars. Frequently, the tumbler form with a metal cap is employed for canning sliced, dried beef.

c. Stuffing. Cans may be filled with meat either by hand or with automatic machinery. Meats are packed by weight. Where whole or unbroken pieces are required, as tongues and Vienna style sausage, the meat for each can is weighed separately and stuffed into the can by hand. Fresh pork sausage may be stuffed into cans by means of a power sausage stuffer, after which the cans are check weighed. Finely divided meats, as potted meats, may be measured automatically and filled mechanically into a number of cans at one time. For meats such as corned or roast beef, the pieces may be uniform in size, grossly weighed by hand in a scoop, placed into a hopper of a stuffing machine and forcibly ejected into a can. Usually a revolving stuffer has 6 to 8 hoppers, each with a small hole in the center of the bottom. Below each hopper is a can box in which empty cans are placed and after stuffing removed by hand. Above each hopper is a plunger which at certain intervals enters the hopper at the top and forces the meat through the bottom opening into the can. When desired a measured amount of soup stock or milk may be placed into each can before or after stuffing. Salt when added may be placed into the can before filling, or with the soup stock. Afer stuffing, the can is removed from the stuffer and scaled (weighed) and meat added or taken away, and further stuffed by hand, if necessary.

Occasionally an overstuffed can results where part of a previous charge of meat is retained in a hopper and stuffed along with a new charge into a can. Such cans are strained and should be excluded for Army meats although the excess weight of meat has been removed.

d. Capping. The top of sanitary cans are sealed on by means of a double seamer without the use of acid or solder.

Crimping is the process of fastening tops or bottoms on cans filled with such products as bacon or sliced, dried beef and precedes floating, a process of bathing the top or bottom edges of cans by a series of spinnings or dippings in molten solder.

After filling, solder cans have the cap soldered on by hand or by machinery, usually with the vent open. A capping machine automatically may hold and rotate packers' cans for hand soldering.

Flux is a composition used to cause solder to adhere to tin thereby reducing the number of pin-hole leaks. Hydrochloric acid is undesirable in flux. A popular flux consists of one-third crushed rosin in two-thirds lard oil, heated to 240°F. until the rosin is dissolved.

Dip is a substance, such as a saturated solution of ammonium chloride which is added to flux just before using, to improve the flux.

A copper is an implement, which, when properly heated is used to melt and distribute solder.

Solder is a fusible compound used for sealing cans or vents. Generally, tin 45 per cent and lead 55 per cent are used. One authority states, "The solder employed ought not to contain more than 10 per cent of lead, and should be confined to the outside of the can."

e. Exhausting. Exhausting consists of removing all possible air from cans by means of a vacuum pump or by heating the contents of the cans before sealing. Cans sealed without exhausting or preheating may have such an increase in the volume of the contents during heat sterilization as to force open the seams. Properly exhausted cans have all surfaces, tightly compressed inward. Non-exhausted cans and leakers do not show this condition and sometimes show "loose tin." Cans containing such products as sliced dried beef and Army bacon which are not processed, are exhausted to inhibit chemical changes and mould growth. Merely exhausting a can does not sterilize its contents (see "Processing").

(1) Vacuum Machine. Sealed cans with the vents open may have a drop of cold solder placed over each vent and then placed into a vacuum machine. The machine is closed, the air is removed from the machine and cans by means of a vacuum pump, and the vents are sealed in vacuum by means of an electric soldering iron manipulated by an operator outside the vacuum machine.

The degree of vacuum attained is indicated by a gauge or a column of mercury. The amount of exhaustion depends on the nature of the contents, and the size and kind of can.

An average exhaustion schedule for canned meats is as follows:

PRODUCT	SIZE OF CAN	VACUUM
		inches
Corned Beef	12 oz.	22
	1 lb.	22
	24 oz.	22
	2 lb.	20
	6 lb.	20
	14 lb.	(1 hr. at 1 lb. steam)
Roast Beef	12 oz.	22
	1 lb.	22
	24 oz.	22
	2 lb.	20
	6 lb.	20
Corned Beef Hash	½ lb.	18
	1 lb.	21
	2 lb.	22
Dried Beef	12 oz.	27–28
	1 lb.	26
	6 lb.	24
Ox Tongue	2 lb.	22
	3 lb.	22
	6 lb.	24
Hamburger Steak	½ lb.	21
	1 lb.	22
Tripe	20 oz.	24
Veal Loaf	½ lb.	18
	1 lb.	20
Pigs' Feet	12 oz.	20
	20 oz.	22
Bacon	5 oz. tin or glass	27
	9 oz. tin or glass	28
	12 lb.	18
Pork Sausage	12 oz.	19
	20 oz.	17
Lunch Tongue	12 oz.	20
	2 lb.	20
Vienna Style Sausage	5 oz.	18
	9 oz.	18
	1 lb.	20
	20 oz.	20
	2 lb.	22
Potted Meats	3¼ oz.	
	5 oz.	

After exhausting the cans and their sealing, the vacuum is released and the cans removed from the machine. Due to the greater air pressure on the outside, the plane sides and ends of properly sealed, exhausted cans will be tightly forced in, in close contact with the meat contents. Defective sealing permits air to re-enter a can resulting in "loose" tin and a dull or empty sound when the can is struck with a drum stick mallet.

When during exhaustion, a portion of the contents of a can closes the vent, preventing free egress of air, the can is called a "kicker." Such a can may be raised above the head and allowed to fall or to be thrown down forcibly on its bottom surface to force the contents away from the vent. This is termed "bouncing."

(2) Preheating. Filled packers' cans with open vents may be placed into a retort and heated with boiling water or a low steam pressure. Due to the heat, the contents of the can increases in volume forcing out the air and variable amounts of the fluid as well. The cans then are sealed. When cooled, a vacuum will result through the decrease in volume of the contents. This method may result in unstable weights due to a variable loss of the contents through the open vents.

Filled sanitary cans without the top may be passed through a steam chamber or preheater on a belt conveyor, and while the contents are hot and expanded the top of the can is double seamed on.

Cans may be preheated with closed vents, after which the solder of the vent is touched with a hot soldering iron, or a hole punched into the top, the can allowed to "blow" several seconds, then re-sealed.

Very small cans may be filled with potted meats heated to about 190°F. and sealed, the hot contents being sufficient to cause a certain amount of vacuum.

f. Processing. This is the application of heat to foods in sealed cans for the purpose of their sterilization. This may be accomplished in an open bath at boiling temperatures or in a closed, steam retort at temperatures higher than those of boiling. Heat penetrates meat slowly. The method of sterilization employed depends on the size of the units and the kind of product they contain. The larger cans and those which are drypacked with spaces existing between pieces of meat require more time for the heat penetration. Fresh meats require temperatures higher than boiling, while some cured meats may be preserved at boiling temperatures. Usually most canned meats are processed in closed retorts under 2 to 10 pounds steam pressure. Ade-

quate processing is essential to insure the proper preservation of canned meats. Some canned meats as Army bacon and sliced, dried beef are not required to be processed. Sausage prepared or packed in oil should be heated to a temperature of at least 160°F., and this temperature maintained within the can for at least thirty minutes. Cans should show good vacuum.

In the open bath method of sterilization, the canned meats are placed into cooking kettles or vats, covered with water and heated by direct steam. The highest temperature which can be attained is 212°F. By the addition of salt or calcium chloride to the water or the employment of a suitable oil bath, higher temperatures may be obtained.

Baskets filled with cans may be placed into closed retorts and sterilized by steam or superheated water. Usually, the heat registering and pressure devices used on commercial retorts are in code and known only to officials of an establishment.

One average processing schedule for canned meats exhausted in a vacuum machine is as follows:

PRODUCT	SIZE OF CAN	PROCESSING	
		Time	Temperature
		hours	°F.
Corned Beef	12 oz.	$2\frac{1}{2}$	220
	1 lb.	$2\frac{1}{2}$	220
	24 oz.	3	220
	2 lb.	3	220
	6 lb.	5	222
	14 lb.	6	227
Roast Beef	12 oz.	2	240
	1 lb.	$2\frac{1}{2}$	240
	24 oz.	3	240
	2 lb.	$3\frac{1}{2}$	240
	6 lb.	4	240
Corned Beef Hash	$\frac{1}{2}$ lb.	$1\frac{1}{2}$	236
	1 lb.	2	236
	2 lb.	3	236
Ox Tongue	2 lb.	2	222
	3 lb.	$2\frac{1}{2}$	222
	6 lb.	4	220
Hamburger Steak	$\frac{1}{2}$ lb.	$1\frac{1}{2}$	234
	1 lb.	2	234

PRODUCT	SIZE OF CAN	PROCESSING	
		Time	Temperature
		hours	°F.
Tripe	20 oz.	2	240
Veal Loaf	½ lb.	1½	236
	1 lb.	2	236
Pigs' Feet	12 oz.	2½	220
	20 oz.	3	220
Pork Sausage	12 oz.	2	236
	20 oz.	3	236
Lunch Tongue	12 oz.	2	240
	2 lb.	3	240
Vienna Style Sausage	5 oz.	1	234
	9 oz.	1	234
	1 lb.	1½	234
	20 oz.	2	234
	2 lb.	2½	234
Potted Meats	3¼ oz.	1½	236
	5 oz.	2	236
Chile Con Carne	½ lb.	1½	230
	1 lb.	2	230

PROCESSING CHART*

STEAM GAUGE PRESSURE	TEMPERATURE
pounds per square inch	°F.
0.304	213.0
1.3	216.3
2.3	219.4
3.3	222.4
4.3	225.2
5.3	227.9
6.3	230.5
7.3	233.0
8.3	235.4
9.3	237.8
10.3	240.0
11.3	242.2
12.3	244.3
13.3	246.3
14.3	248.3
15.3	250.2

* From "A Complete Course in Canning."

Boiling Points of Water

ALTITUDE	BOILING POINT
feet above sea-level	°F.
9,031	195
8,481	196
7,381	197
6,304	200
5,674	201
5,525	202
4,697	203
4,169	204
3,642	205
3,115	206
2,589	207
2,063	208
1,539	209
1,025	210
512	211

g. Chilling. During processing in a steam retort, the internal and external pressures to which cans are subjected are about equal with very little strain on the seams; but as soon as the steam pressure is removed outside of the cans, an internal pressure due to the greatly expanded contents remains until the temperature of the contents is reduced. To reduce this internal strain as quickly as possible so as to prevent strained or open seams, the canned products when removed from the retorts are chilled promptly by being placed under showers of cold water; by immersion in a tank of cold water; or by chilling the canned product after processing, in the retort, under pressure. This is accomplished by turning off the steam, introducing air under pressure equal to the steam pressure, then introducing cold water. Large or underfilled cans when subjected to rapid chilling on one side, may present a battered or buckled appearance and in some instances breaking of the seams. Glass containers are cooled gradually in the retort to prevent breakage by slowly filling the retort with water and gradually reducing the temperature.

h. Caustic Bath. After chilling, cans are inspected for leaks. Defective cans at this time may be repaired and re-processed or opened and contents used over again provided this obtains immediately. However, such cans may be placed in the freezer overnight and this operation conducted the following morning.

Cans coming from the showers are more or less dirty and greasy on the outside. To remove this grease and dirt, so as to facilitate handling, lacquering and labeling and to improve their appearance, the filled cans are placed on a conveyor which carries them through a hot, strong caustic solution, as lye; through a neutral solution to remove the alkali; then showered with fresh water. Cans coming from the alkali solution are dull in appearance. Any leakers noticed at or after this time should be rejected.

i. Lacquering. Commercial enamel or lacquer is a colored varnish containing vegetable resins and gums which may be placed on the outside of dry cans coming from the caustic bath, by hand with a brush, by passing them through a lacquer bath or through a machine which sprays the lacquer on the cans. The cans then are dried by means of air currents for immediate packing, or stacked in pyramidal piles on incubating tables and air dried twelve to twenty-four hours. Lacquer is used to prevent rusting of the tin plate especially in moist climates.

j. Labeling. Cans may have all commercial and required inspection markings embossed on the can or printed on paper labels which are affixed to the cans by hand or by machine. Usually, it is desired that the true name of the product, net weight, name of the establishment, place manufactured, and inspection legends, be shown.

k. Development. Usually after their manufacture, canned meats are incubated in a warm room or on tables over steam pipes at about 100°F. for seven to fourteen days to allow any bacteria in non-sterile cans to develop, resulting in the production of gases and swelling of the cans. Swellers are rejected.

3. Packing, Storage and Shipment. Canned meats may be packed in various sized wooden boxes, cases or crates, care being taken during the nailing of cases that nails do not penetrate cans. Cases may or may not be strapped. Certain labeling and inspection legends should appear on cases.

Canned meats should be stored in a room where they will be kept dry and protected from exposure to extremes of temperature. If cans have been lacquered properly and are kept dry, rusting should not occur. Water soaked or green wood used in the construction of cases may cause rusting. The heaviest tin coating on cans may not be sufficient to guard against rust when stored in a damp place. As a rule the minimum storage temperature should be 34°F., because expansion of the liquid contents by freezing may spring the seams and develop leaks. The ideal temperature is about 45 to 60°F.

Sterilization temperatures may result in some etching on the inside of cans with liberation of hydrogen. The cooling of cans coming from retorts inhibits prolonged chemical action which, however, may continue for certain products especially those containing acid. Heat during storage favors chemical action and the development of springers and pin hole leaks. Canned goods stored under a tin or iron roof at 120°F. will evolve hydrogen eight times as fast as when stored at 66°F. as the chemical rate of action is doubled each 18°F. rise in temperature. When canned foods could be kept eight months at 45°F., they may have deteriorated in three months at 80°F.

When properly canned, packed and stored, many canned meats may be kept under favorable storage conditions two or more years. However, it is desirable to renew stocks annually. Corned beef hash after one year gradually becomes rusty or yellowish in color and has an old or off flavor. Sliced, dried beef in hot climates may not keep longer than thirty days. Army bacon in cans should remain sound a much longer time than crate bacon, however with age the bacon may become rust discolored and contain a high free fatty acid content. Sliced bacon for Army use in cans may keep as long as one year while breakfast bacon in cans may keep for a few months.

During shipment, canned goods should not be subjected to rough handling or extremes of temperature. At shipment, each car of Army canned goods should be checked by the veterinarian or his assistant, record being kept of car numbers and initials, car seal numbers, bill of lading number, destination and routing of the car, the checker's name, and the date.

4. Veterinary Examinations. a. Scope. The steps involved in the veterinary examinations of canned meats intended for troops, begin with a consideration of the sanitary source of such products and include an examination for soundness of all ingredients used; the sanitary supervision of, and methods employed in the cutting, boning, soaking pickling, curing, cooking, trimming and sorting of meats; the cleanliness of cans, their stuffing, weighing, sealing, vacuum and sterilization; examination of the finished product prior to and at time of purchase including testing for short vacuum, leaks and damaged cans; examination of lacquering and labeling; weighing, packing or other manipulation, handling, storage, receipt and issue with such reinspections as are required. It also includes the sanitary location, construction, equipment, and methods of operation of meat establishments involved, as defined by Army Regulations (see Chapter III, Handbook). Veteri-

narians engaged in the inspection of canned meats should be familiar with all the sanitary requirements of the Surgeon General, of the national and state pure food laws relating to authorized ingredients and labeling, and with all procurement specifications.

b. Inspections prior to Purchase. (1) General. The inspection prior to purchase is the examination made during manufacture or when canned meats are offered for sale to the Government at purchasing points or in the field and includes an examination for sanitation and soundness. In any event the inspecting veterinary or medical officer should be informed a sufficient length of time in advance when and where products are to be prepared, the date of packing and the date when products are to be presented for final inspection before acceptance. Every opportunity and facility should be afforded the veterinarian for the proper inspection of all products. A reinspection for soundness, quality, quantity and package or other examination may be made at delivery before final acceptance.

(a) Sanitation. The general provisions relating to the sanitary location and construction of canning compartments, equipment, personnel, products and methods are discussed in Chapter III. Special attention should be given the sanitary cleanliness of all slicing machines, mixers, stuffers, conveyors, benches and tables. It is important that empty cans are stored in such a manner as to be protected from rain or other dampness, vermin, dust or other contaminations.

(b) Selection and Inspection of Ingredients. Authorized ingredients in general are discussed in Chapters VII, IX and XII. The soundness and condition of carcasses or parts to be used should be passed on prior to such use. Likewise any other ingredients should be examined for their sanitary condition. Vegetables should be inspected for their quality, freshness, cleanliness, and freedom from inedible or undesirable parts. Onions should be unsprouted, firm and well peeled. Potatoes should be well peeled, with all eyes, black spots, discolorations, hollow hearts and decayed spots, removed. If frozen, sour or otherwise objectionable vegetables are put into a meat product, the product should be rejected.

(c) Inspection of Manufacturing Processes. The subsequent handling of the ingredients during their trimming, cutting, boning, sorting, mixing, smoking, pickling, curing, cooking and placing into cans, will require the constant attention of the veterinary officer. The temperatures used in cooking should not be overlooked. Care should be exercised that inedible and undesirable parts or products are promptly

removed whenever discovered, and that they or other like parts or products are not permitted to be used at any stage of the manufacture.

The further steps requiring veterinary supervision are the suitability and cleanliness of the cans, and their stuffing, capping, weighing, vacuum, processing, sealing, sterilizing and cooling, washing, lacquering, developing, labeling, checking, and packing, and the efficacy of the methods adopted in the plant at each stage of the process for detecting leaks, incomplete vacuum, or any other defects. The cleanliness and sanitary condition of all machines, appliances, and utensils used during the process should receive attention.

Some of the main points of inspection of products are in the cutting and trimming rooms, on any receipt, in the grinding and mixing rooms and at the stuffing bench. Attention should be given the sanitary manufacture or source of soupstock, milk, salt or water added to cans, also the kind and amount; the check weighing of cans, balancing the scales at least two times each morning and at least two times each afternoon; inspection for leaks after capping; accuracy of vacuum gauge and the amount of vacuum obtained; inspection of exhausted cans for leaks; inspection of cans in trays ready for processing; adequacy of sterilization, and inspection of the cans after processing and chilling.

Dried beef and smoked bacon are conserved in glass or tin containers without sterilization. All other canned meats which require sterilization should be sterilized the same day that the cans are filled. Defective and leaky cans detected after sterilization is complete should be rejected, and not repaired or repacked unless such is accomplished within six hours after sterilization has been completed; however, if such defective or leaky condition is discovered on an afternoon run, they may be held in coolers of a temperature not exceeding 34°F. until the following day, when they may be repaired or repacked. Sterilization is considered complete when the cans are sufficiently cooled for handling after coming from the retort.

(d) Inspection of Finished Products. After sterilization and cooling, each can is inspected by the veterinary officer for defects and all with incomplete vacuum, or that are leaky or collapsed, should be rejected. Damaged cans may be removed and the contents used if this is done without delay provided such have not been subjected to a caustic bath or other objectionable handling.

Before being packed each can should receive a thorough reinspection and all defective cans rejected. Any improperly lacquered cans should

be set aside for re-lacquering. Cans should be held on tables at least seven days before packing to allow swellers to develop. Unless labeled at once, cans should be marked for identification until the final label is attached.

Whenever at time of purchase it is necessary to determine the exact condition of the contents, a sufficient number of cans representing an aliquot sample of each lot presented should be opened. If any product shows evidence of decomposition as shown by a disagreeable odor, liquefied jelly, off color, and corresponding changes in the meat, it should be rejected. The veterinarian should keep record of the following: Identification data relative to the date and place of inspection, purchase order number, manufacturer, number of cases in lot inspected, number of cases inspected, number of cases sampled, results of all inspections, and action. For car shipments the bill of lading number and the car seal number should be recorded.

External Examination of Cans. In the inspection of a lot of canned meat for purchase, the veterinarian should note that the type of cans used, their size, construction, and embossing or labeling, comply with all sanitary and purchase requirements. Labels if used should be applied properly. Lacquering should be of the kind, quality and color as specified and properly applied. Next an examination should be made for soundness, consideration being given, the cause of can imperfections as those due to the quality of tin, methods of can manufacture or resulting from the canning methods.

Each can should be grasped firmly with the hands. A sound can is firm and tight with no loose tin. The ends of round cans and the sides of square cans should be concave in contact with the contents, showing good vacuum. Sometimes jarring the can on a table will aid in the detection of loose tin. For dry packed products, a tapping instrument may be used to sound or percuss the cans to determine the amount of vacuum. Percussion of canned products containing considerable liquid as soupstock, does not always indicate the true condition of vacuum. The room temperature should be considered. During summer or at hot temperatures a can may show loose tin, which in winter or cold temperatures would show concave ends or sides. Next, shake the can to note if the can is "sloppy" or fluid. The tin should, be examined for rust, nail holes, a buckled, collapsed or damaged condition, and patching. The number of vent holes should be considered, but may not have any bearing on the character of the product or its history, although they sometimes may indicate improper canning methods, poor quality or other conditions.

Following is a list of defects some of which may be found at inspection for purchase, or later during receipt, storage or at issue:

Leaker. A leaker is a can containing a perforation from any cause whereby atmospheric air may enter the can or its contents escape. Leakers may be designated as fast, slow, top, bottom, seam, band, press, cap, vent or body leaks and are caused by defective tin, improper soldering, injuries or other factors.

A fast leaker as the name implies, is found especially after exhaustion and before or after processing. When submerged in water, bubbles of air may be forced from the can. Such a leaker may be repaired and reprocessed if in compliance with sanitary requirements.

A slow leaker usually is due to an imperfection in the tin-plate, whereby air slowly enters the can through a small opening. When submerged in water, no bubbles may be produced. A glass vacuum jar of water may be used for this test.

Top float, bottom float, seam, band and crimping leaks usually are due to defects in manufacture.

A cap leak in a soldered can is one in the solder around the cap. In a sanitary can it may be the result of faulty sealing.

A press leak is due to a crack or break in the tin plate of the body of the can, usually under the lid, due to the improper adjustment of the crimper at the time the lid is crimped on.

A vent leak is one in the solder filling a vent due to faulty sealing from some cause as from "blowers" or "kickers." Vent leaks predominate among defects noticed during canning.

A body leak includes those due to accidental cuts or rust spots in the tin plate of the body of the can.

Pinhole leaks usually are due to small particles of meat or other substance remaining in the rim of the can when being soldered.

When small, square, filled cans are thrown or emptied into a pile, a sharp corner of a can may injure the side of another can, producing a leak. New dyes for embossing, used especially on thin tin plate may produce leaks. Frequently in closing cases, nails are directed inwardly producing nail holes in cans. Sealed cans may have breaks occurring in the tin-plate as a result of buckling or from being collapsed.

Usually leakers may be recognized by their appearance, the concavity produced in the sides and ends by the vacuum having disappeared. Also they may be detected by tapping with a drumstick mallet, which will produce a hollow sound; by holding the can under water and squeezing it; and by heating the can until the temperature

reaches 100°F. in the interior and then allowing it to cool slowly, when if a leak is present, there will be no concavity in the sides or ends.

Sweller. A sweller is a sealed can in which gases resulting from any cause have produced a distention or bulging of the sides and ends. When the bulging is due to air the sweller is also a leaker.

Microörganisms within sealed cans as a result of imperfect sterilization or gaining entrance through leaks, according to their kind, and the storage temperatures, may slowly or rapidly evolve gases which replace the vacuum and subsequently may bulge or swell the container. Putrefactive changes may occur in canned meats without the can being a sweller.

Chemical or electrolytic changes may result in gases being formed within canned products. Bulging of cans also may occur due to freezing, or displacement of contents due to dents.

Ordinarily, swellers may be recognized by the bulging of the ends and sides, and by the sound produced when the can is tapped. A bad sweller is easily detected. Slight swellers may be found by tapping the can and noting the peculiar sound.

Springer. A springer or flipper is a filled, sealed can whose ends may show loose tin, and with one or both ends more or less distended, due to insufficient exhaustion at time of sealing, producing an incomplete or short vacuum; due to overfilling; or due to pressure from a gas. This gas may be in the form of air which has entered the can through a leak, hydrogen evolved through the reaction of the contents upon the tin plate, or from decomposition due to bacteria. Therefore a springer may mean anything from a sound can containing a sound and wholesome product to one which is dangerous.

At production, the vacuum gauges should be accurate, a proper vacuum obtained, the cans should be constructed from a good grade of tin plate and all workmanship and methods in the canning department should be of the highest order, to prevent defective cans.

It is almost impossible to differentiate a slow leaker from a short vacuumed can in the early stages after sterilization, also a large number of springers when incubated develop into swellers. Therefore, in the inspection prior to purchase it is well for the veterinarian to exclude any cans in the least suspicious or showing loose tin from any cause. This would include any cans having a dent in an end, as it is possible on some cans to reduce, temporarily at least, a springer by hitting it upon a pointed object as the corner of a box, so as to make it appear normal.

Upon an inspection in storage sometimes it may be desirable to attempt a differentiation between springers containing sound products and others, unsound, however, Army Regulations provide that the rejection of all leakers, swellers and other defective cans should be recommended. An exception may occur as noted under "e. Inspection at Issue" for canned bacon and sliced, dried beef.

Sometimes it may be desirable to open representative samples. In examining a springer and a leak cannot be found, the can may be incubated four or five days or longer. Usually a slow leak will develop in two to four days. Swellers sometimes require a longer period.

When a can with an incomplete vacuum is exposed to a high temperature, expansion of the contents may cause it to resemble a sweller, but retention of such cans for twenty-four hours at 70°F. will cause return to the original appearance if the condition is due to an incomplete vacuum.

Overstuffed Can. An overstuffed can is one into which an excessive quantity of the product has been introduced, distending the ends and sides. Overstuffed cans resemble swellers in appearance. Cans suspected of overstuffing may be set aside for observation. If the distention is due to overstuffing, no change will occur; if due to swelling, usually it will increase. An overstuffed can gives forth a full sound when tapped with a drumstick mallet, while a resonant sound is obtained from a sweller. In some instances the excess of meat may have been removed but due to the extra strain the can will remain bulged even after exhaustion. In an overstuffed can wherever any part of the tin plate is pressed inward it will remain after pressure is released. The top or cap of an overstuffed can usually is irregular in outline and not smooth.

Collapsed Can. This is one which has collapsed in the vacuum machine because of drawing too great a vacuum and usually is associated with incomplete filling. Such cans are unsightly.

Damaged Can. The term defines itself.

Do-Over Can. A defective can discovered before it entered the caustic bath, and which has been repaired and reprocessed. Some do-over cans may show two or more vents.

Short Weight Can. This is one as the name implies. In small cans the sides may be quite concave and a hollow sound emitted upon tapping, while large cans sometimes may collapse.

Examinations of Selected Samples. Such examinations may be for soundness as well as for specification requirements. It may be de-

sirable first to chill the selected samples to produce a firm product desirable for slicing.

Organoleptic. An external examination should be given all samples as outlined above. The cans should be opened without the escape of, or damage to the contents. Key bands when present may be of good advantage, or a hand or patented can opener used to remove the end. In opening a can by hand, the can opener should be inserted adjacent to the seam just below the top, then by cutting away from the seam around the can until the seam is again reached, the entire top may be turned back so that later the contents may be removed intact.

The odor should be noted, whether characteristic, normal, abnormal, old, due to processing or putrid. The inside surface of the top of the can should be examined to see whether it is bright, etched or containing black spots, apparently iron oxide or sulfide. The condition of the top seam should be noticed. See if any of the black spots from the tin contaminate or are mixed with the contents. Note the fill of the can.

Any liquid that is present, may be poured into a dish and saved. Note its amount, consistency, color and odor. If the odor is not putrid or abnormal it may be desirable to note its flavor.

By making a small hole in the bottom of the can, as with the point of a hand can opener, the contents should slide out easily. The contents should be turned out into a tared dish, being careful to include *all* the contents, including the liquid if part of the product, or, unless the drained weight (as for Vienna sausage) is desired. Weigh the contents. The average weight of a number of samples should be at least equivalent to the net weight declared on the can.

Examine the inside of the can. If any liners are present, note color and if scorched.

Note the appearance of the contents to see if they comply with all requirements and with the labeling or embossing; if uniform; as to quality, ingredients used, handling or manufacture. Note if the constituents are uniform; the number of pieces and if broken or of proper size; if characteristic; free from dark spots, discolorations, undesirable features and if mushy, watery, dry or otherwise.

Next the product may be divided or sliced with a sharp knife. Again the odor should be noticed. The color should be typical, characteristic and uniform. If the product apparently is sound, it may be tasted, if desired. The flavor should be pleasing, normal and free from off flavors.

Laboratory. Cans of products may be forwarded to a Medical Department laboratory in compliance with Army Regulations to determine the amount of vacuum and for histological, bacteriological, chemical or other examinations. Chemical examinations include those for gases, preservatives, adulterations, fatty acids and for compliance with standards.

(e) Packing Inspection. Cases should comply with all requirements. When nailing is specified, it should be done properly and carefully so as not to drive nails into cans. When strapping is required the specified strapping should be used, whether unannealed or annealed, treated to prevent rust, or otherwise. It is advisable when strapping some cases to use a stretcher by which the strap is tightened around a case before nailing. All required markings should appear on cases. It is desirable that the veterinarian's personal inspection stamp giving his name and rank, be stamped on each case.

(2) Beef Products. These include canned roast, corned and dried beef; ox tongue, corned beef hash, meat flour or others as may be specified.

(a) Fresh Roast Beef. Roast beef is seldom roasted by direct fire, but usually is parboiled, canned and then in the processing, so called, "steam roasted."

The fresh beef used is inspected on cutting floor (see Chapter VIII, "Beef Trimmings") and trimmed in the same manner as fresh beef to be cured for corned beef (Chapter IX, Section 5 b). It is desirable that the pieces be somewhat larger than for corned beef, that all soft fat is removed and that the meat is cut after the date of award.

Trucks containing Army beef should be tagged, "U. S. A." Frozen beef to be used for Army roast beef should be handled in the same manner as that used for corned beef. Boned beef shipped in from other points to be used for roast beef also should be handled the same as for corned beef.

At some establishments, the fresh beef is taken direct from the cutting floor to the cooking room, the trucks being tagged "U. S. A." and the tags collected at the cooking room by the veterinarian or by the foreman who turns them over to the veterinarian. The trucks containing fresh meat should be covered, if hauled outside for any distance.

The veterinarian should check up the number of tags received at the cooking room with the number of tags issued by the veterinarian on the cutting floor.

At some plants the fresh beef is placed into soaking vats and allowed to soak in water over night before being cooked. There is no objection to this practice as it gives the meat a brighter color after it has been cooked. If beef is placed into soaking vats, the tags should be reissued and collected at the cooking room. The veterinarian should keep a close count of the number of trucks of meat placed into each vat and the number withdrawn from the same. Commercial beef should not be put into vats containing Army meat. If possible, the Army beef should be cooked in a line of cookers separate from the commercial product. If unable to have a separate line of cookers, those containing the Army beef should be tagged "U. S. A."

The beef should be cut into pieces of uniform size and parboiled until little or no uncooked meat is present. This may be determined by cutting through some of the larger pieces. Parboiling should be sufficient to shrink the meat properly so that during processing an excess of free moisture will not be cooked from the product. Usually the beef is cooked by steam for fifteen to thirty minutes, the steam turned off, and the meat allowed to soak from ten to thirty minutes before being removed from the cooking vat. In cooking roast beef, at times the outsides of pieces will turn red. This may be due to cooking the beef in wooden vats in which corned beef has been cooked for a long time, the pipes and the wood being saturated with saltpetre from the pickle. If possible, the roast beef should be cooked in iron vats, as such may be cleaned readily after corned beef has been cooked in them. This coloring also may be due to hauling fresh beef in trucks in which an amount of pickle remains after the trucks have been used to haul cured corned beef, such pickle being thrown into the cooking vat with the meat and colors the roast beef red. In this event, the veterinarian should require the trucks to be cleaned before the fresh beef is placed therein.

After cooking, the meat is placed on trimming benches, and is trimmed separately from commercial products. All bones, cartilage, tendons, and other undesirable parts which may have been overlooked on the trimming floor should be removed. The shrinkage from the green, boneless meat to the canned weight of roast beef is from 30 to 40 per cent.

Cans used, should be embossed properly as required and otherwise up to specifications. All cans should be washed thoroughly, steamed and the excessive moisture removed before filling. If an automatic soup stock filler is used the veterinarian should check the amount of

soup stock introduced into the cans by this method. This can be accomplished by putting a few empty cans in the machine and not putting any meat in the hopper, and then weighing the amount of soup stock placed into each can. When the soup stock is introduced by means of a ladle, the veterinarian should check the amount placed into each can by this method, and if excessive, should have ladles made to hold the exact amount required.

When soup stock is specified, the meats must be well shrunken otherwise an excessive amount of free liquor may be present in the finished product. The soup stock should be prepared properly, and at time of using, fresh and sound. The veterinarian should see that soup stock is actually used when specified, and not plain water or a weak brine. The cans should be weighed properly and the scales should be balanced at least two times in the morning and two times in the afternoon. If the veterinarian experiences any difficulty in getting the proper weights be should have check-scalers stationed at each stuffing machine to re-weigh the cans before they are capped.

The methods used in capping, exhausting, and processing roast beef vary at different plants. At some establishments soldered cans are stuffed, capped, and run into a vacuum machine where vents are sealed under about 23 inches of vacuum. The cans then are placed into a steam retort and may be processed at 10 pounds steam pressure for two hours and forty-five minutes. In other establishments, sanitary cans are used. The cans are stuffed, run through a sanitary capper, through the vacuum machine and then processed the same as soldered cans. In some houses, sanitary cans are stuffed and run through a super-heater into the sanitary capper and processed the same as stated above. At other times, soldered cans are stuffed, capped, and then the vents are closed, not under vacuum. The cans then are placed under steam-pressure for about one hour at a low-steam-pressure, about 1 pound, removed from the retort and the soldered vents opened by means of a hot soldering iron, when a blow-off occurs. After the blow-off the cans are re-soldered while hot, replaced into the retort and processed for one and one-half hours at 12 pounds steam pressure.

After the cans are removed from retort they are showered, inspected for short vacuums, leaks, damaged cans or other defects, and then sent through a washing machine and to the labeling room. Cans should be lacquered according to specifications.

Each morning the veterinarian should retain and examine a number of samples of the finished product. The embossing should be legible.

The lacquer should be according to specifications and completely covering the cans. Cans should be free from rust. A good vacuum should obtain without any suggestion of loose tin, buckling or of collapse.

The cans should be chilled properly in a cooler or ice box as warm roast beef does not retain its shape when removed from the can. Cans should be examined along the same general lines as outlined under (1) (d) above.

The meat should be dark gray, reasonably firm and compact and not sloppy. The jelly or liquor should be clear or with some coloration from the meat but not brown or excessive in amount. Proper trimming is evidenced by freedom from blood clots, bruised pieces, bones, cartilage, excessive fat and other gross connective tissues. The meat should be of good quality, tender and free from coarse muscle fibres, and not too dry. The flavor should be characteristic and pleasant.

(b) Corned Beef. Corned beef for the Army may be specially prepared for issue or for reserve rations, or the commercial product may be specified. The curing of corned beef is described under Chapter IX.

It is not desirable to accept shipped in cured meats from other establishments unless they have been cured under the supervision of an Army veterinarian. When shipped in, the veterinarian should be notified in order that he may make a thorough examination for marks of prior official inspection, for soundness, quality and condition. Accepted meat should be tagged and handled the same as described under Chapter IX.

Long cured corned beef is cooked by parboiling. For the Army, the meat should be cooked in a separate line of cookers, if possible, and not confused with commercial products. If it is impossible to have a separate line of cookers, each cooker containing Army beef should be so tagged. The cooking of corned beef varies somewhat at different establishments. Regular long cured corned beef usually is cooked under steam from fifteen to thirty minutes when the steam is turned off and the meat allowed to soak for fifteen to thirty minutes before being removed from the cooker. The short cured corned beef is usually given a shorter cook, i.e., from five to fifteen minutes, and in most instances it is not allowed to soak.

After the meat is properly cooked, it is taken to the trimming tables where the excessive connective tissues, soft fats, tendons, bones and cartilages are removed from the beef. The veterinarian should note

if the meat is properly cured. This can be determined by cutting through cooked pieces, and if meat is not properly cured the center will be a dark brown color instead of red. In short cured corned beef some small gray centers the size of a dime may be passed. These spots usually disappear after processing and the curing seems to continue after canning.

The veterinarian should notice if any of the pieces are sour. The meat should be trimmed separately from commercial products.

After the meat is trimmed, it is sent through the cutting machine, and then to the stuffing machine. Two workmen should be stationed at each stuffing machine to sort over all meat before it is put into the hopper, to remove any bones, cartilage, tendons, and other undesirable parts which may have been overlooked on the trimming floor. The shrinkage of the green, boneless meat to the canned weight is from 40 to 45 per cent.

All cans should be embossed properly as required, otherwise up to specifications, washed, cleaned and steamed, and free from excessive moisture and flux, before being placed into the stuffing machine. When required, for reserve rations the cans may be parchment lined.

Soup stock should be used as specified. The veterinarian should note how soup stock is made. It should be made from fresh bones by boiling. Rib and neck bones make very good soup stock for corned beef. This stock should be made fresh. If there is an automatic machine for introducing soup stock into the cans, the veterinarian should make a test to determine the amount of soup stock placed into cans by this device. This may be done by placing a few empty cans into the machine and not putting any meat in the hopper. The amount of soup stock in the can, may be determined by weighing. If soup stock is placed into the cans by means of a small ladle, the veterinarian should measure the capacity of the ladle to determine the amount introduced by this manner. If excessive, the veterinarian should require smaller ladles to contain the exact, required amount.

After stuffing, the cans are weighed. At some houses the meat is weighed before it is put into the hopper of a stuffing machine. Check weighers should weigh each can before capping. The veterinarian should re-weigh a certain number of cans at intervals during the day to determine whether the check-weighers are properly weighing the cans. Cans are then capped. The vents are sealed in vacuum under about 23 inches of vacuum. The cans are then inspected for leaks due to poor soldering of vents, and the sound cans are sent to the process room.

The processing of corned beef varies at different plants. For the long cured product, some plants put the corned beef into retorts, and process at 9 pounds steam pressure for two and one-half hours. At some establishments a hot water bath is used, long cured corned beef being immersed in boiling water three and one-half to four hours and short cured corned beef for six hours. When the open vent method of exhaustion is employed, weights should be checked carefully upon removal from the retorts to exclude cans which are underweight due to an excessive "blow off."

The veterinarian should retain and open a number of cans of chilled finished product along the same general lines as outlined under (1) (d) above. Weights should be checked carefully. The beef should be sliced with a sharp knife and examined to see if sound, properly cured, properly trimmed, free from excessive moisture and excessive fat, if properly processed and of proper flavor and texture. It should be of good appearance, uniformly bright red in color, with no uncured areas, tender, palatable and not too dry; and free from blood clots, gross connective tissues and coarse muscle fibre. The finished product should not contain jelly or salt in excess of requirements.

Commercially cured corned beef of the best quality may be specified, the brand usually being stated in each proposal and contract and the product purchased on sample. The veterinarian, being guided by the purchase requirements, should make a thorough inspection of markings, cases, packing, labeling, lacquering, style of cans, quality and condition of tin plate used in their construction, the amount of vacuum, and the net weight, soundness, condition, quality and preparation of contents as shown by opening a sufficient number of representative cans as necessary. (See current specifications.) The average net weight should not be lower than that indicated on the label.

(c) Corned Beef Hash. The selection of corned beef for Army corned beef hash is discussed under Chapter IX. The corned beef used may be either the long or short cured product, being cured under Army inspection and prepared the same as for regular corned beef.

The beef should be subject to veterinary inspection when taken from the vats, and the vegetables before being cut up.

The vegetables used for hash should be fresh and of the best quality. Dehydrated vegetables are not desired unless specified. Sound, fresh, medium sized, smooth potatoes are desirable. Old potatoes, stored several months are not as good as fresh potatoes. Potatoes should not be too mealy or disintegrate during processing. Small, knotty,

scabby and hollow potatoes are wasty. Unsound, frosted, frozen, sunburned and sour potatoes should be excluded. Potatoes contain about 66 to 80.5 per cent moisture. This moisture may be reduced somewhat by parboiling which also facilitates removal of eyes and skin.

Potatoes should be well peeled. This may be accomplished by first parboiling them seven to ten minutes then while hot scraping the skins off by hand, or by running them through a washer and peeler. All eyes, skins, black spots, dark and hollow centers should be removed else these may appear in the finished product as black spots. Frozen potatoes may turn black upon cooking and feel "soapy" or "slippery." Peeled potatoes should be used as soon as practicable and not allowed to soak in water. If held in a cooler over night, they should be inspected to determine if sour. Sour potatoes, if used in Army hash, would require rejection of the hash.

Sound, fresh, white (not red), dry onions are desirable. Dehydrated onions should not be used unless specified. Frosted, sprouted, rotted, larvae infested, decayed, mouldy or otherwise objectionable onions should be excluded. Onions should be well trimmed and free from roots, skins and stems. To hold peeled onions, they may be immersed in cold water.

Pepper used should be sound and fresh.

Well trimmed, corned beef, potatoes, onions and pepper in specified amounts may be cut together.

Potatoes should not be cut too fine or made into a mush, and the onions should not be reduced to a pulp, as may obtain when run through an enterprise grinder. A silent cutter cuts and tears the hash too fine. A rotary or a rocker chopper may be used. Onions may be added whole, or first put through a hasher. The hash should be chopped uniformly and not too coarse or too fine. A watch should be used on the first batches to fix an approximate time for a certain desired state of fineness. This will act as a guide for subsequent batches.

Weights should be watched carefully to see that there is no tendency to reduce the amount of onions or meat to be used, and that the correct amounts are used. Usually 2 ounces of pepper is the maximum amount to be added to 100 pounds of hash. It is said that the flavor of pepper is increased through cooking, therefore it is well to cook up a small batch and test for pepper to ascertain the desired amount. Hash coming from a cutter or chopper usually is well mixed and blended, ready for stuffing.

All cans should be embossed properly as required, otherwise up to specifications, washed, cleaned, steamed and free from excessive moisture.

Usually hash is stuffed by means of an air-compressor. The veterinarian should see that water is not introduced into the cans while they are being stuffed and also that water is not added to the hash during the mixing and chopping processes.

All cans should be weighed before being capped. The scales should be balanced at least two times in the morning and two times in the afternoon. If the veterinarian experiences any difficulty in getting the proper weights he should insist upon cans being check-weighed before being capped.

The methods of capping and exhausting cans vary at different establishments. In some houses, soldered cans are exhausted and the vents sealed under about 23 inches of vacuum. The cans then are put into retorts and processed under 8-pounds steam pressure for two and one-half hours (for 2 pound cans). This time and pressure varies somewhat at different establishments. The cans may be stuffed and run through a sanitary capping machine, then through a vacuum machine and processed the same as soldered cans.

At some establishments, sanitary cans are stuffed and run through a long covered box, called a super-heater or exhaust box. The temperature in this box should be kept as close to boiling as possible and the contents of cans heated so as to expand and force out the air. The time required to pass through this exhaust box varies. At some houses it requires one and one-half or two minutes, and at others ten to fifteen minutes. The longer period seems to give the better results, preventing slack cans.

From the super-heater the cans are run directly into the sanitary capping machine where they are capped while hot. If the contents are not sufficiently heated, a short vacuum may result, causing a springy can. Such defective cans may be put through a vacuum machine and the vents soldered under 23 inches of vacuum and then re-processed. If the cans are allowed to become cool between the super-heater and the capping machine, slack cans will result. Cool cans should be returned to the super-heater before capping.

Another method used is to stuff packers' cans, cap the cans and leave an open vent. These cans are not run through the vacuum machine, but are taken direct to the process room. Here, the cans are put into a steam retort and processed with an open vent at a low steam pressure

(about 1-pound, for one hour). Cans are then taken from the retort and the vents soldered immediately, while the cans are hot and the contents expanded. After the vents are soldered, the cans are replaced into the retort and processed under 10-pound steam pressure for two hours.

Usually the commercial processing is accepted, however thorough warm room tests should be conducted to insure that the sterilization has been complete.

The veterinarian should retain and open a number of cans along the same general lines as outlined under (1) (d) above. Weights should be checked carefully. The hash should be dry and free from moisture; crumbly, falling apart readily; of evenly mixed, uniform, small cubes, and not mushed up or pasty. The meat and vegetable components should appear about equal in amount. The hash should not contain any onion skins, or black spots due to improperly prepared potatoes. There should be some onion flavor, while the pepper flavor should not be too pronounced.

Commercially prepared corned beef hash may be specified, the bids usually stating whether the product is foreign or domestic. The veterinarian should be guided by purchase requirements and make a thorough inspection of markings, cases, packing, labeling, lacquering, style of cans, quality and condition of tin plate used in their construction, vacuum and the net weight, soundness, condition, quality and preparation of contents as shown by opening a sufficient number of representative cans as necessary. (See current specifications) The average net weight should not be lower than that indicated on the label.

(d) Sliced, Dried Beef. For the Army, this product may be specially prepared as a sales article or for reserve rations. Usually this product is purchased upon sample, the brand being stated in each proposal and contract. The curing and other preparation of dried beef is discussed in Chapter IX.

Usually, commercially cured dried-beef hams divided into knuckles, insides and outsides, are specified. It is desirable to accept only insides and knuckles unless outsides are specified in the contract. Each piece should be given a thorough inspection and tried, properly trimmed and sliced. Cans should be cleaned and embossed properly and otherwise complying with requirements. For reserve rations the cans may be parchment-lined and provided with a special scoring (see specifications). Usually, small pieces, scraps and "chipped"

beef are excluded. Scales should be balanced properly and all weights checked. After filling, the cans are capped, vents sealed under vacuum, inspected for leaks, then lacquered. Before packing, the filled cans again are inspected, all leakers being rejected. Cans improperly lacquered should be relacquered before shipment.

Glass containers are hermetically sealed in vacuum using rubber gaskets and tin covers. The outside air pressure holds the cover in place on an exhausted tumbler.

When the purchase order specifies the net weight of contents of cans and the brand of sliced, dried beef to be furnished and which is packed prior to date of award, the veterinarian should make an adequate inspection by opening at least one can in every tenth case on large orders and at least one can in every three cases on smaller contracts, to determine soundness, quality, net weight of contents, method of packing and other features.

(e) Beef Tongues. The curing of beef or ox tongues is described under Chapter IX. Beef tongues are always cured before canning. They should be whole, sound, of good quality, in good condition and of proper weight so as to comply with purchase requirements for the finished product. Mutilated tongues and pieces should be excluded.

The tongues may be soaked twelve hours, placed into a cooking vat, covered with water, steam turned on and the tongues cooked at boiling temperature one and one-half to two and one-half hours or until cooking is complete. The cooking shrink is about 32 per cent. The cooking water is drawn off and may be utilized in meat extract.

The cooked tongues are placed on a trimming table where the mucous covering (skin), all bones, cartilage, surplus fat, salivary glands, gross connective and inedible tissues are removed. This trimming shrink averages 3½ per cent. A sanitary trier inspection should be given all tongues, inserting the trier ventrally 3 inches posterior to the anterior attachment of the tongue, at an angle supero-posteriorly (upward and backward) through the thickest part of the tongue. Any sour or otherwise unsound tongues should be rejected. It is claimed that sour tongues when canned frequently develop into swellers.

Soup stock which usually is added in the ratio of 1 ounce per pound of tongue, should be prepared properly, sound and in the amount required by specifications.

Cans should meet all sanitary and purchase requirements and lined when desired with parchment liners. Cans are stuffed by hand, it being the usual practice commercially to remove a small slice from the

base of a tongue which is overweight. Filled cans are capped, sealed in a vacuum machine under about 18 to 20 inches of vacuum for 2 pound cans or 16 inches for 6-pound cans (when specified), inspected for leaks and processed. One establishment processed $1\frac{3}{4}$ pound cans under 6 pounds of steam pressure, two hours and 6 pound cans under 4 pounds of steam pressure, three hours. Another establishment places the cans which are sealed (not in vacuo) into a retort under 1 pound of steam pressure one hour, removes the cans, opens the vents with a "blow off," quickly reseals the cans which then are processed three hours under 2 pounds steam pressure.

The cans are removed, showered rapidly, inspected for leakers, put through a "lye" washing machine, piled on tables, properly lacquered with the specified lacquer and developed at least seven days before packing.

The veterinarian should retain and open a number of cans of chilled canned tongue, along the same general lines as outlined under (1) (d) above. Weights should be checked carefully. All liquid in the can should be solidified into a clear, firm jelly adhering to the tongue. The tongue should be free from the outer skin or mucosa (part of the submucosa remains), other undesirable tissues as specified, and mutilations. The tongue should be sliced, noting especially cure. The meat should be of bright, uniform color and sound.

(f) Meat Flour. The specification requirements (if any) regarding canning should govern. An objectionable odor may develop in cakes of bread and meat flour mixture even when the moisture content is 5 per cent or lower.

(3) Pork Products. (a) Bacon. Canned bacon for the Army may be specially prepared, or a commercial product may be specified. The curing of bacon is discussed under Chapter IX.

Army bacon may be cut into pieces or into uniform slices and canned.

Bellies or extra short clears for Army canned bacon are selected, trimmed, cured and smoked as for crate bacon, except it is not necessary to cut extra short clears before smoking.

The smoked bacon is taken to the canning floor where the veterinarian inspects it for soundness, quality, and trim (see specifications), eliminating defective pieces including those with bruises, seeds and ragged edges, thin fat backs and "scrappy" pieces. Accepted pieces should be cleaned and wiped before cutting or wrapping.

The bacon is cut into pieces with the ranges of weights as specified, eliminating scraps. A horizontal incision, cutting between the face of

the bacon and skin is not desired. A book, that is a piece cut through the meat to the rind, but not through the rind and bent back in the shape of a book, is considered as one piece and not as two pieces.

Engorged blood vessels sometimes are present at the back edge of a belly imbedded in the fat tissue, being exposed only upon cutting into the belly. Such should be trimmed away and rejected. Cans should comply with specifications including any required embossed data. Usually rectangular cans of 12 pounds net capacity are used, being hand made with each side seam lapped and soldered and the bottoms and tops crimped on and soldered using a rosin and oil, or rosin, flux. It is essential that heavy tin plate be used in the construction of these cans as commercially it is impracticable to cut the bacon into such sized pieces as will just fit the can and give the sides of the can the necessary support when exhausted. Cans should be washed, cleaned, wiped dry, and, free from flux, dust or other contamination, before being packed.

The pieces of cut bacon are weighed out accurately into groups, each group of pieces being of the exact weight to be placed into a can. Each group of pieces is wrapped with heavy paraffin or waxed paper which is sufficiently large to completely cover the bacon. For a 5 x $7\frac{3}{4}$ x $12\frac{1}{4}$ inch can, a 24 x 30 inch paper should be used and for a 6 x $7\frac{1}{2}$ x 11 inch can, a 24 x 36 inch paper. Bacon is wrapped to prevent contact with the tin as it is thought that fatty acids which develop during storage may act upon the tin plate.

A funnel-shaped filler may be fitted over an empty can and the wrapped bacon pushed into the can. The veterinarian should see that the paper is not torn or disarranged when the cans are filled.

The scales should be balanced at least two times in the morning and two times in the afternoon, and a sufficient number of cans re-weighed daily to assure that the proper weight is being placed into each can.

After the cans are stuffed, they are capped, floated to solder the caps, vented, placed into a vacuum machine and the vents sealed under about 15 to 18 inches of vacuum. After coming from the vacuum machine, the cans are tried by means of a small stick to determine whether the cans have been exhausted properly. All leakers should be repaired and re-exhausted.

Cans then are placed on labeling tables and wiped before being lacquered. Before being packed the cans are held sufficiently long to insure soundness, when they are re-inspected especially for leakers. All leaky cans should be rejected, and repaired before being packed.

All cans that are not lacquered properly should be re-lacquered before being packed.

Usually, canned bacon, is packed for overseas shipment in crates which hold 6 cans or 72 pounds. All required markings should appear on the specified cases. Cases should be nailed securely and properly strapped. Care should be exercised to insure that the specified strapping is used.

In strapping the cases it is advisable to use a stretcher by which the strapping can be drawn tight around the box before being nailed. The veterinarian should pay particular attention to the strapping to see that it is done properly and stretched tightly around the corners of the case so as not to tear off in handling. The strapping should extend completely around each case and overlapped at the end for a space of about 2 inches.

When required, Army bacon may be prepared in uniform slices, excluding scraps, weighed out into definite amounts as specified for each can, wrapped in heavy paraffin paper, placed into clean cans as specified, the cans closed, sealed in vacuum, outside surfaces cleaned, lacquered and packed in cases along the same general lines as described for canned Army bacon in pieces. Before slicing, the bacon should be prepared by removal of the skin and chilling until firm to insure even, uniform slices.

The production and selection of commercial, sugar cured bacon is discussed in Chapter IX. The specification requirements as to quality, preparation, packing and markings should be consulted. Usually the brand of product is stated in each proposal and contract.

Cans should comply with all specification requirements including embossed data, cleaned properly and lined with paper, if specified, before being packed. Weights should be checked and scales balanced at least two times in the morning and two times in the afternoon. Cans are packed, capped, vents closed under vacuum, tested for leaks, lacquered, held sufficiently long to insure soundness, then reinspected for leaks. All leakers should be rejected and all cans not lacquered properly, re-lacquered before being packed.

All required markings should appear on the specified cases. Usually, advertisements are not desired on the cases or boxes. The cases should be nailed securely and strapped unless otherwise specified. The strapping should be done properly and carefully so as not to drive nails into the cans. Each morning the veterinarian should retain and open a number of samples along the same general lines as described under

(1) (d) above, ascertain the net weights, and examine the contents for compliance with all sanitary and procurement requirements.

When packed before the date of award, the purchase order usually specifies the net weight of the contents of each can and the brand to be delivered. The verterinarian should make the necessary inspection, opening at least one can in every tenth case on large orders and one can in every 3 cases on smaller contracts, to determine soundness, quality, quantity or net weight and methods of packing.

(b) Pork for Beans. The selection of pork for canned beans with pork is discussed in Chapter IX.

(c) Fresh Pork Sausage. The preparation of fresh pork sausage is discussed in Chapter XII.

Usually, soldered cans are used when the sausage is canned in bulk, or sanitary cans when stuffed into links. Cans should be cleaned and embossed properly and otherwise complying with requirements. A sausage stuffer may be used for filling bulk sausage into cans; or, the meat first may be put into hog or wide sheep casings 8 links to the pound, with links of such a length as just will fit the inside of cans into which they are packed; or, otherwise, as specified.

Cans should be exhausted properly. Filled soldered cans are run into a vacuum machine where the vents are stopped under about 23 inches of vacuum, placed into a steam retort, processed at about 12-pounds steam pressure for two and one-half hours, removed from the retort, showered with cold water to cool them and to stop the cooking process in order that the meat will not be over-processed, run through a lye wash to remove any grease so the lacquer will adhere to the can, then placed on lacquering tables and lacquered according to specifications.

Each morning, the veterinarian should retain and open a number of cans along the same general lines as outlined under (1) (d) above. More or less liquor and rendered fat produced during processing, will be found free in the cans but should not be in excess. As the meat is canned raw, it is expected to shrink during the high temperatures, through the extraction of moisture, and fat. Usually, more fat will be rendered from loose sausage than from those in casings. At ordinary temperatures the fat should be reasonably firm and white. The meat will be friable and grayish in appearance.

For culinary purposes all the contents of a can should be heated together.

All required markings should appear on the specified cases. The cases should be closed securely and strapped as required. For over-

seas shipment unannealed strapping treated to prevent rust, sometimes may be specified.

(4) Miscellaneous. (a) Vienna Style Sausage. The preparation of Vienna style sausage is discussed generally in Chapter XII. The veterinarian should be present and inspect the cuts of beef to be used before they are trimmed. All bruised, sloppy pieces, also skirts, meat from heads, offal and cuts containing an excessive amount of connective tissue, should be rejected. All accepted meat should be trimmed, removing all tendons and excessive connective tissue and then placed in barrels or trucks and labeled U. S. A.

The veterinarian should be present when the meat is ground and see that only U. S. A. inspected meat is used. Usually the meat is ground into an emulsion and about two and one-half per cent of salt and fifteen per cent of water and ice are added. The trucks containing this emulsion are labeled U. S. A. and are placed in a cooler to cure over night.

Pork trimmings should be inspected on the pork cutting floor, and should be fresh, sound and otherwise complying with requirements. Frozen trimmings should not be used unless specified. The pork trimmings are ground and combined with the beef emulsion and other ingredients. Usually not more than 25 per cent of water is added at time of manufacture.

The mixture or emulsion formed is placed into a stuffing machine and filled into specified casings. The sausages are hung on racks which are tagged "U. S. A.," placed into a smoke house and smoked about four hours. This time varies at different houses. After their removal from the smoke house they may or may not be cooked (see specifications), allowed to cool, taken to the canning floor, inspected for curing and condition, cut into proper lengths (unless already in small specified links) and stuffed into cans. All pieces should be of good size and not so long as to require their twisting to fit the cans. Small pieces, scraps and ends are not desirable, where cut lengths are specified. Where links are specified, broken links should be excluded.

Cans should be cleaned and embossed properly and otherwise complying with specifications.

Water should not be added to the cans before filling and sausages should not be dipped or soaked in water before they are stuffed into cans. The sausage should be dry.

Filled cans should be weighed properly and the scales balanced at least two times in the morning and two times in the afternoon. In

the event of difficulty in obtaining proper weights the veterinarian should insist upon the filled cans being check weighed before capping. However, it should be borne in mind that the drained weight of the finished product will be considered the net weight which is placed on the can.

To the filled cans there may be added water, a weak brine or soup stock, or nothing at all, to fill up the spaces between the pieces.

Cans are capped and then stopped under about 23 inches of vacuum, or sanitary cans may be packed, run through a super-heater and capped in a sanitary capping machine.

Cans may be processed in a steam retort at 10 to 12 pounds pressure for about two and one-half hours. At some plants cans are processed at 5 pounds steam pressure or 227°F. for two hours.

Another method is to process with open vents one-half hour at 1 pound steam pressure, close vents, process about one and one-fourth hours at 10 pounds steam pressure, remove from retort, shower with cold water to prevent over-processing, inspect for leaks and other defective cans, run through a lye wash, place on lacquering tables and lacquer according to specifications and allow the lacquer to dry.

Each morning the veterinarian should retain and open a number of samples of the finished product along the general lines as outlined under (1) (d) above. The links or cut lengths should show uniform length, just contacting the ends of the can, and should be straight and not twisted. Short links, ends, small pieces and bursted casings are not desirable. The smoking color should be uniform. Black pepper if used may show as black specks underneath the casings and lowers the appearance of the product.

Some of the links or lengths should be divided longitudinally through the center with a sharp knife to produce a smooth cut surface for inspection. The sausage should present a bright cured color, uniform throughout. Sausages prepared from undercured meat may be gray or show cured outer borders and undercured gray centers. The texture should be fine, smooth and not friable. The odor may be noted from the cut surfaces or by breaking some of the sausages. The flavor also should be noted, and should be agreeable, mild and not pronounced or too dry.

(b) Veal Loaf. The preparation of veal loaf is discussed in Chapter XII. Either soldered or sanitary cans may be specified. Cans should be cleaned and embossed properly and otherwise complying with requirements. Veal loaf may be stuffed by hand or with a power stuffer, and subsequently handled as for other canned meats.

Daily during preparation, the veterinarian should retain and open samples of the finished product along the same general lines as outlined under (1) (d) above. Some rendered fat may be present outside the meat, and a small amount or no free liquid. When removed from the can the meat mass should retain its shape.

(c) Soups. Soups of various concentrations made from properly prepared and cooked, inspected, sound, fresh meats, vegetables, spices, salt, water or other authorized ingredients, may be specified. The formula of the product may be furnished by the bidder and purchases made on sample or otherwise as specified (see specifications). All raw materials entering into their combination, all processes involved, and the finished product should be given veterinary sanitary and procurement examinations in compliance with Army Regulations.

(d) Other Products. Other meat products may or may not be specified from time to time. For the general information of Army veterinarians the general manufacture of potted meats, lunch tongues and tripe, are discussed briefly.

Potted or Deviled Meats. These may contain any kind of meat of an edible nature and include potted or deviled ham, potted tongue, potted beef and miscellaneous products known as potted meat by-products. Generally, the meats are cooked by parboiling to remove excess moisture, mixed with the other ingredients, chopped fine in a silent cutter, placed into a jacketed holding kettle where the product is heated and agitated, run into a stuffing machine, stuffed hot (150 to 195°F.) into small sanitary cans, sealed immediately, washed, processed and subsequently handled as for other canned meats. At some establishments the filled cans before sealing may be run through a "steamer" to produce the vacuum.

Deviled ham may consist of ham, boiled for about four hours, ground to a paste with spices and pulverized salt added, and canned. For the Army, properly inspected and sound, strictly fresh, sweet, cured and smoked hams are used, the ham being cooked properly, finely ground and pure, clean spices and salt added (see specifications).

Potted tongues may consist of pork tongues which are soaked twelve hours in fresh water, boiled four hours, ground and mixed with spices.

Lunch Tongues. Usually, these are prepared from cured pig and sheep tongues, although pig tongues usually are the ones put out under this name. The cured tongues are cooked about one-half hour, with about 33 per cent shrink. After cooking, the mucosa is not removed from the tongues, and a piece inspection with a trier as for ox tongues

is not given. It is claimed that a better flavor results where the tongue is not "peeled." Usually lunch tongues are packed in 12 ounce and 6 pound net, cans. From the green to the canned weight, lunch tongues shrink 45 to 48 per cent.

Tripe. The cooked tripe may be cut into suitable widths, weighed, rolled, stuffed into cans, and milk and about 6 per cent of salt added. It is said that the milk may prevent tripe from turning black.

c. *Inspection on Receipt.* This is conducted whenever or wherever canned meats are accepted along the same general lines as outlined under Chapter VIII. At camps or posts, at least a 10 per cent can inspection for soundness should be made on receipt. When a large percentage of defective cans are found it may be desirable to make a 100 per cent inspection on receipt. This inspection may include such re-examinations for quality, quantity, containers, cases and markings as required by purchasing officers at time of delivery before final acceptance.

d. *Inspections during Storage.* The inspection of canned meats in storage is along the same general lines, where applicable, as outlined for fresh meats, Chapter VIII. Re-inspections are maintained from time to time while canned meats are in storage when considered necessary by the veterinarian or the quartermaster concerned, or directed by proper authority. This is done by opening the cases and examining each can.

The inspection of cans for soundness consists of an examination for leaks, including nail punctures, swellings, and other defects. The rejection of all defective cans should be recommended and some system of handling the cans should be advised which will insure the rejected cans being kept separate from the others.

The Army veterinarian should be familiar with all canned meats in storage covered by the seller's guarantee against unsoundnesses due to improper preparation or resulting from defective containers. He should note the date of manufacture or delivery of the several stocks of canned meats and inspect such stocks from time to time in order to detect deterioration. A thorough inspection also should be made of canned meats just prior to the time of expiration of the guarantee. When any inspection produces rejects, that fact should be reported immediately to the Quartermaster concerned in order that reclamation can be made. (See "Action," Chapter VIII.)

As a general rule, meats should be stored in a room where they will be kept dry and protected from exposure to extremes of temperature.

They should not be exposed to a temperature below 34°F., because expansion of the liquid contents by freezing may spring the seams and develop leaks. If the cans have been lacquered properly and are kept dry, rusting should not occur.

e. Inspection at Issue. A very careful examination should be given each can on the day of issue. (See inspection at issue of fresh meats, Chapter VIII.)

The following procedures should apply to the veterinary examination of certain non-processed meats at issue when not covered by a guarantee, or, provided the same has expired: The inspection of Army bacon in 12-pound cans may be limited to an examination of the cans to determine if the meat is properly protected, this product being placed into cans for protection and not for preservation. Defective cans should be opened and the meat inspected for soundness along the same lines as for crate Army bacon.

In the inspection of breakfast bacon, sliced, in cans, each can should be examined carefully and if there is any evidence of swelling or of leaks, or if nail punctures, breaks due to rust, or other defects are present, the can should be opened and the contents carefully examined.

Upon re-inspection of sliced beef, if cans are found to be expanded due to gas, yet the product is sound and wholesome after thorough aeration, rejection should not be required.

f. Action. (See "Action," Chapter VIII, parts "d" and "e" above, also purchase requirements involved.)

CHAPTER XI

Products Inspection (continued)

E. RENDERED MEAT PRODUCTS

1. General. The rendered edible products as discussed in this section include edible oils, fats and mixtures of animal and vegetable origin. Under beef fats are included oleo products, tallow and mention of sheep fats; products covered under swine fats include lards, lard compounds and lard products; while mixtures embrace especially oleomargarin and lard substitutes.

The qualification of terms and labeling of various rendered products intended for interstate or foreign commerce should comply with Federal requirements.

2. Commercial Production and Storage. a. Beef Fats. The important edible fats rendered from the adipose tissue of cattle are the oleo products and edible tallow. Oleo products include oleo stock from which oleo oil and oleo stearine are derived. Inedible tallow, greases and neatsfoot oil are discussed under Chapter XIII.

The parts used in the production of edible fats should be from properly inspected food carcasses, sound and free from contaminations and other objectionable conditions. A good grade steer may produce from 55 to 70 pounds of edible fats, a canner cow 20 to 25 pounds, while the general average for cattle is about 42 pounds per head. The killing, offal, cutting and shop fats and parts which are rendered to produce edible fats, include omental (caul), mesenteric (ruffle), intestinal (gut), stomach, pluck, and kidney fats; tripe, liver and beef cutting trimmings; bones; lymph nodes; spinal cords, and other tissues as discussed in Chapter VIII. Gut fats are derived principally from the large colon (middles), cecum (bung) and small intestines, and include chip fat trimmed from the intestines and machine fat resulting from fatting machines. Stomach fats include those from the paunch, peck and rennet. Pluck fats are derived from the heart, trachea and mediastinum. Bones include skull, jaw, thigh, buttock and cutting room bones. Cutting room trimmings include several fats, important among which are cod, crotch, brisket and beef ham fats.

Fats are graded out as No. 1 and No. 2 fats. No. 1 fats are from good quality carcasses and include all fats except machine, certain beef cutting and shop fats. These latter, with fats from poor quality carcasses are placed into No. 2 grade.

Killing or hot fats should be handled as quickly as possible into the oleo department where they are trimmed, sorted, washed, weighed and chilled. Bones should be washed clean. Shop fats from wholesale and retail markets should be inspected as to sanitary source and soundness. Sound shop fats may be soaked in a chilling vat over night prior to rendering, while contaminated, musty, rancid or other unsound fats should be excluded.

Beef fats may be rendered by direct steam heat whereby steam is brought into contact with the product or by indirect steam heat where steam confined in coils or jackets in conjunction with mechanical agitation are employed. By the indirect method which is used in the manufacture of oleo stock, any desired rendering temperature may be maintained. It is claimed that desired flavors are retained in fats rendered by this method.

(1) Oleo Products. Oleo stock or "premier jus," is prepared by rendering selected beef fats. Mutton-caul, ruffle and paunch fats may be used to produce lower grades of oleo products but are not included in the higher grades because of distinct unpleasant flavors which they may impart. All raw materials or fats used must receive sanitary, prompt and efficient handling to insure a high class product. Oleo products are not sterilized at any stage of their production therefore any taint or decomposition resulting from irregular temperatures, delay in chilling the fats, drying of the fats or from using low grade or unsound fats, will affect their flavor and grade. Holding fats over a period of time under unfavorable conditions of heat, moisture and bacterial activity may result in an increase of the free fatty acids, in rancidity or in other deteriorations.

All killing floor and offal room fats should be kept clean and chilled as soon as possible after slaughter. Fats contaminated with feces or dirt should be excluded. Improperly trimmed fats from the heart, liver, tripe or casings, which contain heavier tissues may become "sinkers" in washing and chilling vats and thus deteriorate. Chilled fats as kidney, cod, beef ham, beef tongue, cheek meat and other cutting fats should be well trimmed, sorted and used as soon as possible.

(a) Oleo Stock. In the preparation of oleo stock, the fats are classified and graded. Caul, ruffle, pluck and stomach fats from good qual-

ity carcasses and No. 1 suet from the cutting room may be saved for No. 1 grade; lower grades of pluck, stomach and cutting room fats and gut fat for No. 2 grade; and yellow fats from grass fed or other cattle may be held for a special grade.

Washing and Chilling Fats. Large pieces of killing floor fats are cut into strips by hand or sliced by machine to facilitate rapid and uniform cooling. Fats are washed and soaked in a vat of fresh, clean water at 50 to 60°F. to remove the animal heat and blood, then they are transferred into a large, chilling vat of filtered water, cooled by means of brine pipes or ice. The temperature ranges of the water should be from 38 to 45°F. The fats remain in the chilling vat from four to twelve hours with occasional stirring. Some vats may be provided with false bottoms to retain sinkers, otherwise sinkers settling to the dirty bottom of a vat would become contaminated and subject to rejection. Further sorting of fats occurs in the chilling vats. The chilling of fats inhibits deteriorations and facilitates hashing. Chilled fat from cutting rooms may be hashed without further preparation other than trimming and sorting.

Hashing. Chilled fats are drained and hashed, usually through an enterprise grinder equipped with a $\frac{1}{4}$ inch plate, directly into open steam or water jacketed melting kettles of 1500 to 5000 pounds capacity.

Melting and Settling. The filled kettles are heated gradually and uniformly accompanied with a slow, steady mechanical agitation of the fats, for about two hours, at which time the temperature of the melted fat (oleo stock) is about 150 to 160°F. The agitator arms are removed and about one-half to one hour is allowed for the scrap, containing nitrogenous material, to settle, and for skimming. Settling is aided by the addition of salt. Skimmings are rendered in a subsequent kettle of fat.

Clarifying. After settling in the melting kettle, the oleo stock is siphoned into a centrifugal clarifier or into a clarifying or settling kettle, care being exercised not to include any of the scrap or bottom from the melting kettle. In the clarifying kettle the oleo stock is allowed to settle one and one-half to three hours at 135 to 144°F. using salt to aid in this process.

The scrap in the melting kettle is dropped into a tank underneath where it is re-heated and more oil for No. 3 oleo stock or for edible tallow is recovered, while the refuse is used in cracklings or tankage.

After clarifying, the bottom contents of the clarifying kettle are drawn off until the fluid oleo stock is clear, bright and free from moisture. The oleo stock then is drawn off through a flannel strainer either into tierces or into seeding trucks. The yield of oleo stock from fats is from 60 to 75 per cent with an average of 68 per cent.

(b) Oleo Oil and Oleo Stearine. *Seeding.* From the clarifying kettles the oleo stock may be run, through a "seeding" machine or run into clean, hardwood trucks of 800 to 1000 pounds capacity. Such trucks sometimes are lined with galvanized iron. Prior to their filling, trucks may have some salt sprinkled on the bottoms to prevent "sour bottoms." After being filled with the melted oleo stock, more salt may be sprinkled over the top to retard sourness. The loaded trucks are run into a room maintained at a uniform temperature of 85 to 90°F. and allowed to remain undisturbed three to four days during which time "seeding" occurs. Seeding refers to the fats of a higher melting point (oleo stearine) crystallizing and separating from the more fluid fats (oleo oil). The stearine sinks to the bottom of the truck except for a thin crust which remains on the surface of the oleo oil.

Pressing. After seeding, the stock is broken up, mixed and uniformly stirred by means of a sanitary, mechanical stock breaker, shovel, paddle, hoe or rake to insure more uniform results during pressing. From a sanitary standpoint, the breaking up or mixing of stock by means of hands and arms is not desirable.

The broken up stock is taken to the press room which is maintained at about 88 to 90°F. Presses should be sanitary and press cloths clean and dry. The thoroughly mixed stock is dipped from the truck by means of a clean ladle and placed on canvas press cloths or wrappers which are spread on a clean filling table. Each filled wrapper then is folded and placed into the press which will hold about 2000 pounds of stock. After the press is filled a slow, steady, mechanical pressure is applied to force the oleo oil out of the press cloths.

Oleo Oil. The oleo oil coming from the press gravitates into a collecting tank where it is heated carefully at 118 to 120°F., run into tierces, and then stored at 40 to 50°F. from two to seven days, to grain. If disturbed during the graining period the oil will have a soft, smooth, pasty appearance which for sales purposes is undesirable. Oleo oil should be coarsely granular but with a finer, smoother grain than oleo stock. The desirable melting point is below 85°F. The desirable upper limit of free fatty acids is 1 per cent. The oil should

have a clean, pleasant, wholesome, neutral or bland, nutty flavor. The yield of oleo oil from oleo stock is about 60 to 65 per cent.

Commercially, three or more grades of oleo oil are produced. No. 1 oleo oil is derived from the highest grade of fresh fats from corn fed cattle, as caul, ruffle and other No. 1 fats, properly trimmed and free from extraneous tissue and contaminations. The finished oil should not contain more than 0.2 to 0.4 per cent of free fatty acids. No. 2 oleo oil is made from machine and cutting fats, poor killing fats and other No. 2 fats. No. 3 oleo oil is made from poor cutting and shop fats and the further rendering of bottoms. Special yellow oil derived from yellow fats and used for natural colored margarins is considered as pertaining to No. 3 grade. Oleo oil is used in the manufacture of oleomargarin. (See "c. Miscellaneous.") Oleo oil of good quality, stored at uniform cooler temperatures, may keep several months.

Oleo Stearine. After pressing out the oleo oil, pressure is released, the press is unloaded and the solid oleo stearine is shaken out of the press cloths directly into a bin or into a melting tank. From the bin, oleo stearine may be packed by means of a rotary packer into slack tierces of about 500 pounds net, and stored at 45 to 55°F. Dry storage is essential to prevent mold growth and other deteriorations. Oleo stearine should be pale yellow to creamy white in color, and possess a clean, neutral odor. Its average titre or solidification point is from 49 to 51. Hard stearine has a melting point of 160 to 165°F., soft stearine 120 to 125°F. and extra soft stearine 90 to 95°F. It is used for hardening lard substitutes in the manufacture of chewing gum, candy and some lower grades of margarin. The lower grades of oleo stearine are used in tanning.

(2) Edible Tallow. Edible beef fats not otherwise used in oleo products may be rendered into edible tallow, in steam pressure tanks, or in open wooden vats by prolonged boiling in water heated by direct steam.

In addition to edible beef fats the following beef products may be used if sound and of an approved source: aortas, tail joints, residue from oleo kettles, rennets, bones, scrap tallow, and gall bag, skirt, cheek, gullet, tongue, sausage and other trimmings, all of which are graded according to soundness and condition.

Pressure rendering, similar to that for prime steam lard, is employed especially for washed beef fats, trimmings and other parts, and results in edible tallow and tankage. The edible tallow is filled into tierces or shipped in bulk in tank cars while the tankage is used in stock food or fertilizer according to grade.

The open vat method of rendering is used to recover "open rendered" edible tallow and other products, as bones for commercial purposes (see Chapter VIII, "Cattle Offal"). Sound, fresh, washed bones from an approved source and including skull, jaw, thigh, buttock and other cattle bones from the offal and cutting rooms, are placed into cooking vats containing cold water. After a vat is filled with bones, the water is drawn off, the vat re-filled with water, steam turned on and the bones cooked eight to forty-eight hours at about 190°F., during which time the vat usually is skimmed two times. Thigh and buttock bones may be cooked eight and one-half hours, skulls and jaws ten and one-half hours and large knuckles and cutting bones forty-eight hours.

Edible tallow is used in lard compounds, substitutes and lower grades of margarin, in baking and for inedible purposes.

"Tallow" refers to beef tallow, while "mutton tallow" is that derived from sheep fat.

b. Swine Fats. (1) Lard. Edible lard is the sound, approved fat of properly slaughtered, healthy swine; melted, rendered, "tried" or extracted and which may be strained, settled, clarified or otherwise treated by approved sanitary methods to remove tissue and other impurities.

Histologically, fat is contained in various types of cells, especially those of areolar connective tissue which have become specialized into adipose tissue. Fat occurs in many regions of swine carcasses as beneath the skin, retroperitoneally and in the mesentery, caul and other parts.

The properties of swine fat are influenced considerably by the species, age, sex and nutritive condition of the animal from which it is derived, the part from which taken, its prior handling and soundness. In structure and consistency, fat tissues retaining animal heat are transparent, homogeneous, slightly stringy or oily. After the fat stiffens or firms out it may become dull, greasy and crumbly. The fat of corn fed swine is pure white and becomes firm on chilling, while that from swine fed exclusively on peanuts may be very oily, soft, yellowish white and remain soft and pliable after chilling at 32°F. for thirty-six hours. Disease such as hog cholera, and certain feeds, may cause a yellowness of the fat. Off flavors or odors may result from feeding materials, from uremia, sexual odor, contaminations or unsoundness. Acorns fed to swine are said to produce a bitter flavor, fenugreek a manure-like odor and certain other feeds, fishy or other off flavors and odors.

Chemically, fats are fixed fatty compounds composed of glycerin with various members of certain groups of acids, especially fatty acids as stearic and palmitic, and unsaturated acids such as oleic. Glycerin is capable of combining with one, two or three such acid radicles to form mono-, di- or tri-compounds of the same kind of acid, or a mixed glyceride. Chemists have been unable to separate out tri-stearin from lard and in this respect it appears to differ from beef and mutton fats. Lard may contain a-palmito-distearin.

Fats intended for lard manufacture should be chilled and handled properly to insure a pure and wholesome product. Any fats, contaminated with ingesta or otherwise unsound should be rejected. Rancidity of fats due to oxidation, also hydrolysis, are discussed briefly under "Spoilage of Meat," part 6, Chapter VIII.

Swine fats may be classified as leaf, killing or butcher, cutting and salt, cured or sweet pickle fats. Corresponding terms may be applied to lards made from these respective fats. Leaf fat is the best grade of fat for lard. It is a layer of soft, white fat extending retroperitoneally on each side of a hog carcass from about the center of the belly toward the flank, a large amount being found in the "pocket" of the flank. Killing or butcher fats are those removed from a carcass during its dressing on the killing floor, and from the offal. Killing lard is dark in color and usually has a "hoggy" odor and flavor. It is considered better than sweet pickle or salt lard but not as good as cutting lard, although the melting point of killing lard may be higher than that of cutting lard. Cutting fats are those trimmed from commercial cuts and include ham, shoulder, jowl, back and belly fats from which the lean meat has been removed and with or without the skin on. Cutting fats rank next to back fat which may be considered a cutting fat or as a separate class. Cutting lard is fairly white, and has a good texture, flavor and odor. Back fat is a very good grade of fat for lard and is rated next to leaf lard. Salt, cured and sweet pickle fats are derived from cured pork cuts. Lard made from such fats is of a lower grade, usually being dark in color, with a "cured" or "pickle" odor and flavor and of poor texture. Usually before being used, such fats are soaked in cold or warm water several hours and then heated to the boiling point to remove salt and other curing agents.

The various kinds of fats may be rendered separately or judiciously combined, and run into distinct packages.

Several classifications of lard are used and include bladder, keg, guts. kettle rendered, prime steam, dry rendered and hydrogenated lards,

Kettle rendered lards include leaf, choice and neutral lards while under prime steam is considered refined prime steam lard. Bladder lard is leaf lard run into bladders. Keg lard or "hog dripping" has been defined as that made from the mixed fat from the entire hog. "Guts" according to one authority "represents the fat from every part of the hog, except the lungs and heart." For the purpose of this text there are considered kettle rendered, steam rendered and dry rendered lards with varieties and grades, varying with raw materials used, methods of manufacture and other factors.

(a) Kettle Rendered Lards. *Kettle Rendered.* This includes butcher, kettle rendered, and kettle rendered leaf lard which may be rendered in an open or closed kettle by means of dry steam enclosed in a steam jacket or by fire, and not under pressure, not in contact with steam and without any water being added. It is considered the most desirable lard on the market for household purposes.

Butcher lard may be rendered in small packing houses or in butcher shops from edible swine fats or scraps by direct fire heat. Sometimes such a product may be yellow or dark in color and have a burnt odor and flavor.

In modern packing houses large steam jacketed open kettles or cylindrical tanks are used to render kettle rendered and kettle rendered leaf lard. Each tank has a capacity of 3000 to 6000 pounds, is provided with an outlet cock at the bottom and is equipped with a revolving agitator.

Kettle rendered lard may be made from varying proportions of leaf, caul, back and cutting fats and ham facings, while kettle rendered leaf lard is made from leaf fats. One packer used two-thirds leaf fat and one-third back fat in a high grade lard.

All fats used should be fresh, clean and free from contaminations and other unsoundnesses. Old fats may be high in free fatty acids. Usually the fats are freed from any adherent pieces of skin. Leaf, back, and other fats may be chilled at 34°F. to facilitate hashing prior to melting. Chilled or fresh fats may be hashed through a power hasher equipped with a $\frac{1}{2}$ or $\frac{5}{8}$-inch plate, directly into the melting kettle. Hashing of fats promotes rapid and uniform rendering.

Before starting the hasher about 45 pounds of steam is introduced into the steam jacket of the melting kettle and the agitator started. The agitator revolves about 16 to 20 times per minute. An agitator is necessary so that all fats will be rendered uniformly. The hashed fat is introduced and cooked for about two hours at which time the

temperature has increased to about 230°F. From $\frac{1}{2}$ to 2 pounds of bicarbonate of soda per 1000 pounds of melted fat may be used to maintain the white color of the lard. The pressure of the steam may be increased to 260°F. or cooking continued until the cracklings are yellow and all moisture has been eliminated as shown by the hot lard being free from rising bubbles and being quiet on the surface. Rendering may require two to three or more hours, after which the agitator is stopped and removed, the steam shut off and the contents of the kettle dropped to a settling and strainer tank. After standing about twenty minutes, the lard is filtered through a $\frac{1}{8}$ inch strainer, equipped with 2 or more thicknesses of cheese cloth, into a storage tank, the cracklings being retained. Settling may occur in the melting kettle but it is claimed that a darker colored lard results by this method. The lard from the storage tank may be filled into containers.

Lard stearine or hydrogenated lard may be added when lard is intended for hot climates or to "stiffen" soft lard.

Leaf fat yields about 92 per cent lard and back fat and pork trimmings 80 to 85 per cent.

Kettle rendered lard is run into containers hot, small pails and cans at 160°F., large pails, cans and tubs at 120 to 140°F. and into tierces at 100 to 120°F. Because of the high temperature of the lard at filling, tins should have the seams soldered. Cartons and boxes are unsuited as containers for the same reason.

The filling room is kept under refrigeration to promote rapid cooling. Tins, pails and tubs with open tops may be placed under currents of cold air produced by swinging boards or electric fans. This rapidly chills the surface, forming a firm crust. The lower stratum of lard as it cools, contracts and causes a roughening or wrinkling of the surface crust. Leaf lard has the deepest and most fluffy wrinkles and is referred to as "crinkly" top. Kettle rendered lard other than leaf, placed under electric fans, becomes wrinkled on the surface to a less degree than leaf lard, and the surface is referred to as a "Boston" top. In tierces a "grainy" lard is produced. Some houses may run pails three-fourths full of kettle rendered lard, allow the lard to chill, then fill the packages up with leaf lard, to produce crinkly tops.

In the final package, kettle rendered leaf lard should show a characteristic wavy, fluffy, crinkly top. It is the finest in grain and the whitest in color of lards.

Kettle rendered lard is white, sometimes with a tendency to a yellowish cast, of good grain and has a kettle flavor. It becomes rancid

more quickly than refined prime steam lard. The top of the lard in the final container may be rough or "curly," so-called "Boston tops," due to the action of air currents produced by electric fans during cooling. The maximum moisture content is about 0.1 per cent.

Cracklings may be rendered into prime steam lard, or subjected to hydraulic pressure, a steam process, heated, or otherwise treated to remove any remaining unrendered fat so that finally they contain from 6 to 35 per cent of lard. Cracklings may be sold for poultry food or ground into flour and used in potted meats or sausages.

Neutral. Dry Neutral. This is the product usually prepared. No. 1 neutral lard is made from leaf fat and No. 2 neutral lard from back fat or a mixture of leaf and back fats. Its preparation is similar to that of kettle rendered lard. The tank used is water jacketed and provided with a revolving agitator. A steam jacketed fat hasher is used to hash the fats which are first chilled at 34°F. for twenty-four to forty-eight hours. All equipment should be in a sanitary condition prior to hashing. Used kettles should be washed out with a hot water hose before filling. Rendering should be conducted in compartments free from foreign odors.

About 5 pounds of steam are used to heat the water in the jacket to about 100°F., the agitator is started and the plastic, hashed fat is introduced into the kettle. The fat is hashed finer than for kettle rendered lard. After filling, the temperature is brought up to about 128°F., and rendering completed in fifteen to thirty minutes. The scrap in a kettle of neutral lard rises to the surface and is known as "pumice." After melting, the lard may be dropped quickly into a receiving and settling tank where about 7½ pounds of salt per 1000 pounds of lard may be used to aid settling. After settling twenty minutes, the lard is strained through cheese cloth into a storage tank. After thirty minutes the lard is skimmed, and run into tierces at about 120°F. The filled tierces are rolled into dry storage maintained at 40 to 56°F., stored on the bilge with bungs up, bungs removed and tierces allowed to remain without disturbance ten to twelve days to grain. Neutral lard in tierces should never be rolled as this would destroy the grain. Neutral lard should be shipped in iced cars. No. 1 neutral lard is used in margarin manufacture and No. 2 in the confectioners' trade. As the product is not sterile, its keeping qualities are limited, and rancidity may develop quickly.

No. 1 neutral lard should be tasteless, except a faint flavor like hickory nuts, odorless, clear in color, of smooth grain, and free from acidity, impurities and foreign odors or flavors.

No. 2 neutral lard is not as white and is not as fine in grain as No. 1.

Leaf fat yields about 80 to 82 per cent of neutral lard and the scrap upon being rendered into prime steam lard, 10 to 12 per cent. Back fat yields about 65 to 75 per cent of neutral lard and the scrap $18\frac{1}{2}$ per cent of prime steam lard.

Wet Neutral. This is prepared in a similar manner to dry neutral, except the chilled fat may be hashed into ice water to remove blood to produce a cleaner, more neutral and whiter product, or, after melting and settling the lard is run into vats of ice water where the white, flaky masses are broken up with paddles until the lard is chilled. The lard then is drained and packed into tierces.

(b) Steam Rendered Lard. *Unrefined.* Tanks. Upright, cylindrical, closed tanks of thick boiler plate, with steam tight rivets, and calked seams, of any desired size or capacity but with the same general construction, are used to render prime steam lard. The size depends on the capacity of the establishment. Usually the diameter of the shell is 4 to 6 feet and its height 8 to 16 feet.

In the large packing houses usually such a tank extends through two floors, the fats being introduced at the top and drawn off a few feet above the bottom of the tank on the floor below. The average tank of 35 to 40 tierce capacity has a shell 14 feet long, $6\frac{1}{2}$ feet in diameter with a 30-inch cone at the bottom and a dished or cone head at the top. The bottom of the cone is provided with a 12-inch gate valve, a slush valve and two steam inlets connected with a boiler. The shell has two or three draw off cocks, between 4 and 5 feet from the bottom, placed one over the other and a little to one side. The top is provided with a manhole about 18 to 22 inches, a pet cock and is connected with a water condenser. A blow off valve is also provided.

Raw Materials. All edible swine fats and parts not used for other purposes may be used for prime steam lard. It may consist of killing, cutting, sweet pickle and occasionally leaf lard. Sweet pickle lard is the poorest grade of lard and usually is tierced and sold as such or mixed with other steam rendered lards. Usually prime steam lard is made by mixing 60 per cent of cutting and 40 per cent of killing lard. It is not stirred, bleached, filtered or run over rolls.

The fats and parts used include bones, as head, jaw, neck, blade, shoulder, knuckle, fresh pigs' feet, brisket, back, loin, fresh and pickled ham and canning bones; trimmings, as head, jaw, cheek, tongue, shoulder, side, sweet pickle belly and ham, outside, dry salt, heart, kidney, liver, melt and stomach trimmings; ham facings; fats, as head, spare rib, pluck clear plate, cala, giblet, loin, back, caul, ruffle, leaf, bladder, black gut, bung gut, cutting, from fleshing machine, from canning room, and neutral lard scrap; parts, as jowl butts, snouts, lips, feet, tails, pancreas, gullets, ears and ham skins; skimmings, as ham boiling vat, pigs' feet cooking, lard, and from back fat skin washer; and inside scrapings as crotch, leaf and neck.

A high class product will result only when proper care is given the raw materials. Fats should be fresh, clean and free from contaminations, foreign odors, rancidity, or other unsoundnesses otherwise the finished product may have a strong, disagreeable odor, is cloudy in appearance, darker in color, and generally of a lower quality.

Rendering. Dirty, unclean or otherwise insanitary rendering tanks or other equipment will not result in a high class product. The rendering tank should be washed clean, after which the bottom is closed and clean, cold water is introduced into the tank until it is about one-fourth full. Sometimes the cone may be filled with green bones to prevent fats from packing and later interfering with the free flow of steam. Fats and other parts to be rendered are introduced through the manhole at the top. To prevent packing of fats, a long pole may be used to distribute them. Packing or "balling up" may produce sour lard, as decomposition may ensue prior to heat penetration. During the charging of a tank, a small amount of steam may be turned on to heat the fat gradually. Usually the tank is filled three-fourths to four-fifths full or up to within 18 inches of the manhole. If too full the tank may "foam" during cooking and there would not be sufficient space for "rolling" the tank if desired. If not more than one-half full the lard produced may be watery and not of a good, steam flavor.

After charging, the steam is turned off, most of the water is drawn off, the manhole is secured tightly, and steam is turned into the tank gradually until a full head of 35 to 40 pounds is attained. A higher temperature may result in a burnt flavor. The escape valve should remain slightly open and the pet cock wide open to allow free escape of gases, otherwise the lard would absorb such gases resulting in unpleasant flavors. It is important that the steam pressure be uniform

during the rendering period as otherwise the lard may have a high free fatty acid content and sometimes a streaky, cloudy appearance. During the first four or five hours of cooking, the tank operator occasionally may momentarily lift the safety valve arm to cause a violent agitation of the tank contents ("rolling" the tank) in order that large packs or balls of fat may be broken up. He also may feel the side of the tank for cold spots due to packing of fats, which if not reduced may cause souring of the lard. These packs may be broken up by "rolling" or the condition overcome by shutting off the steam and drawing off the water. The latter method is also applicable where "foaming" of a tank occurs. Usually it takes seven to nine hours to completely render a tank of lard under 40 pounds of steam pressure or eleven hours under 35 pounds. Where a pronounced steam flavor is desired a longer rendering time is employed. It requires a longer time to render bones than fats, and longer for killing than for cutting fats, therefore killing fats usually are rendered separately and one hour longer than cutting fats.

After rendering is complete, the steam is shut off and the pressure reduced gradually by opening the exhaust valve slowly until the pet cock indicates that no steam pressure remains in the tank. The manhead then is removed, the floaters (if any) skimmed off with a long handled dipper and the lard allowed to settle two to three hours. Fine salt (about 15 pounds) may be used to aid precipitation and settling. A settled tank of cooked lard contains an upper stratum of melted lard, a middle zone of tank water and a residue which has settled to the bottom.

Drawing Off. The tank water may be drawn off through the slush valve or the lower draw-off valve until the lard is down somewhat below the level of the upper draw-off valve. If lowered too much, the lard level may be raised sufficiently by introducing hot water at the bottom of the tank. The lard is drawn off from the upper draw-off valve and passed through a small separator into a receiving tank. This tank is provided with baffles to retain any moisture present, which if allowed to remain in the lard would cause sourness. A test tube sample of the lard containing moisture may show the moisture sinking toward the bottom as small droplets or "bubbles" or the sample may be opaque. From the receiving tank the dry lard, free from moisture passes over the "overflow" into a settling tank. Usually these are shallow-tanks, not over 30 inches in depth, with a sloping bottom,

a draw off valve at the lowest point and another a little above the bottom; and steam coils in or underneath the tank to drive off any moisture in the lard. The lard may remain in the settling tank several days. Lard at 90°F. should not be held for more than one week, while at 75°F. it may be held two weeks. Bucket samples should be taken at the upper draw off to see if the lard is clean. The lard at about 120°F. is run into lard tierces of 360 to 392 pounds net capacity and stored without disturbances at about 35°F. until grained out; or the lard may be pumped to a refinery or storage tank. Prime steam lard may be shipped in closed tierces or in tank cars. It may be refined and used in other grades of lards, in compound or to produce lard oil and lard stearine.

Properties. The Chicago Board of Trade requirements for prime steam lard as follows: "Standard prime steam lard should be solely the product of the trimmings and other fat parts of hogs, rendered in tanks by the direct application of steam, and without subsequent change in grain or character by the use of agitators or other machinery, except as such change may unavoidably come from transportation. It must have proper color, flavor and soundness for keeping, and no material which has been salted must be included. The name and location of the renderer, the date of packing, and the grade of the lard shall be plainly branded on each package at the time of packing. Each tierce shall be properly filled. Prime steam lard of superior quality as to color, flavor and body may be inspected as 'Prime Steam Lard, Choice Quality,' and shall also be delivered on contracts for Prime Steam Lard."

Prime steam lard is coarser in grain than other lards, has a bluish tinge and a distinct cooked flavor. The odor and flavor is not as good as when refined. No. 2 prime steam lard is defective in flavor and color and very coarse in grain. Such lard may be produced from sweet pickle fats.

Properly prepared prime steam lard in tierces has been kept more than one year when the temperature did not exceed 40°F.

Prime Steam Lard Yields. One authority states that killing fats yield about 65 per cent and cutting fat 80 per cent, while another gives the yield for killing fats as 75 to 80 per cent and cutting fats 70 to 75 per cent.

The following gives the average yields obtained on a number of tests:

PRODUCT	PER CENT	PRODUCT	PER CENT
Whole heads	30–33	D. S. fat backs	75
Skinned heads	18	Loin fat	90
Head fat	35	Loin bones	20
Head bones	9	Back bones	15–18
Snouts	18–26	Fresh ham fat	73–91
Snout trimmings	18	S. P. ham fat	75
Lips	10–20	Ham facings	72–75
Cleaned lips	36–38	Fresh ham bones	20
Cheek trimmings	38–39	Cured ham bones	16–19
Tongue trimmings	21–70	Leaf fat	92–95
Gullets	15	Scrap leaf fat	90
Jowl butts	65–70	Pancreas glands	55
Jowl trimmings	63	Giblet fat	12
Neck fat	73	Melts	1.2
Ears	11	Trimmed stomachs	3
Neck bones	15–17	Kidney scrap	96
Fat shoulders	65	Pizzle strings	1.5
Clear plates	60–82	Bladder fat	69
Cala fat	40–75	Bung gut fat	35–59
Shoulder bones	20	Ruffle fat	64–66
Blade bones	11–12	Pluck fat	29
Knuckles	13–15	Heart trimmings	15
Feet	10–17	Killing fat	47
Brisket, lean out	75	Cutting fat	77
Brisket, bones	18–32	Outside trimmings	70
Spare rib fat	90	S. P. outside fat	45
Bacon belly	72	D. S. trimmings	55
Belly fat	65–73	Mixed fat	60
S. P. belly trimmings	45	Skins	10–52
Fresh belly trimmings	60	Lard skimmings	60
Back fat	80–87	Tails	18–25
Light fat backs	53		

Tankage. After the lard has been drawn off, the remaining water and tankage is dumped into a dumping box, allowed to settle several hours, lard skimmings recovered for the next tank of lard, tank water concentrated into "stick" for fertilizer, and the tankage consisting of residue from bones and fat is pressed and the recovered grease used in soap manufacture.

Refined. Refined or pure lard is prime steam lard which has been treated to stirring, bleaching, filtering and rapid chilling processes.

Bleaching. Usually, this is done with Fullers earth, which should be used in such a manner as not to impair the quality of the lard, and which is later removed during the process of manufacture. Unauthorized ingredients and others which are not used include sodium hydroxide, carbonate and bicarbonate; alum; lime, and borax.

A definite amount of lard is introduced into a "clay kettle" or "earth tank." This tank of about 1000 to 8000 pounds capacity, is made of steel, is equipped with steam coils on the bottom and sides and with some means of efficient agitation as a mechanical agitator or a compressed air line. The lard is heated from 130 to 170°F., usually about 150 to 160°F. Higher temperatures may produce a "scorched" flavored lard. The lard is placed under agitation and a definite amount of Fullers earth is added. Ordinarily ½ per cent is used, but for dark colored lard 1 per cent. The Fullers earth in suspension quickly absorbs the color of the lard, and in about five minutes the lard is pumped through a filter press to remove the earth, which if allowed to remain in contact with the lard for fifteen minutes or if too great in amount, may impart an "earthy" flavor to the lard.

Filtering. The filter press is a series of steel plates equipped with heavy, double, canvas, press cloths sewed together at the center hole. Press cloths should be clean, dry, free from holes and smooth. Lard with 3 per cent of moisture cannot be filtered as the earth absorbs the moisture and clogs the filter press.

The filter press retains the Fullers earth and fine particles of scrap while the lard is forced through the cloths in a bleached, clean condition and is conducted to holding tanks.

After Fullers earth has accumulated in a press, first air is forced through the press, then steam to remove lard from the press cloths. The press is opened, cloths allowed to dry when the earth is shaken out and press cloths, if in good condition may be cleaned.

Cooling. In the holding or receiving tank 20 per cent of straight cutting lard may be added. This has a tendency to darken the lard but improves the flavor. From the receiving tank the lard may be chilled quickly in a lard agitator or passed over "rolls" for this purpose to chill the lard before the stearine crystallizes out or separates from the oil; otherwise if not chilled the lard would have a coarse grain. The rolls give firmness and a finer grain.

The rolls are large, revolving, horizontal steel cylinders, cooled on the inside by the circulation of cold water (water roll), cold brine (brine roll), or by the direct expansion of ammonia (direct expansion

roll). (The expansion roll usually is used for lard compounds or substitutes.)

The water roll is maintained at about 50 to 60°F., and the brine roll at 0 to 10°F. The lard at 100 to 105°F. is pumped or run by gravity so as to come into contact with a brine roll on the outer surface of which it is chilled then scraped off into a trough or picker box at 40 to 50°F. where a "worm" forces it out of the trough into a conveyor for filling into packages, or if cooled to 70°F. it may be pumped into an agitator, a tank equipped with agitator arms, which is thought to give the lard a better color. Too much agitation may incorporate too much air into the lard so as to reduce its keeping qualities and by making it light and fluffy its bulk is increased.

From the agitator the lard is pumped to the filling tables, filled into various containers when it is ready for shipment.

When two rolls are used the first one usually is a water roll with a trough on each side of it and the second one brine, the lard coming from the water roll at about 80 to 90°F. is congealed on the brine roll.

Rapid chilling and agitation produce a firm, homogeneous, smooth, uniform lard.

In order to stiffen soft lard or make lard sufficiently firm for hot climates, stearine or hydrogenated lard may be added.

Packing. Refined prime steam lard is run into containers in almost a firm condition. Usually the filling room is kept at about 60°F. The packages include bladders, cartons, boxes, cans, pails, tubs, kegs, barrels, tierces, and metal drums. Bladders are filled especially for export trade. One pound net cartons equipped with paper sacks or liners may be filled automatically and weighed. This style of package is suitable for the retail trade. Partitioned wooden boxes, lined with paper so folded that a lap occurs at all seams, are used for domestic and export trade, each section holding about 25 kilograms of lard. For export, the lard usually is "stiffened" with hydrogenated lard or lard stearine. Cans and tin pails from 1 to 100 pound net capacity are used. Pails may or may not have "Summer" tops crimped on. Kegs, tubs and tierces may be silicated inside or contain parchment paper liners. Barrels and tierces, usually are filled through the bung.

(c) Dry Rendered Lard. This is edible lard which is rendered by the dry cooking method as described under "c. Inedible Tallows and Greases," Chapter XIII. Samples of the finished product examined were coarse grained and had the appearance of kettle rendered lard.

(d) Storage of Lards. The keeping qualities of lard depend on its sanitary production, soundness and condition of raw materials used; sanitary condition, type and suitability of containers employed and the temperature and other conditions of handling and storage. (See "Veterinary Examinations.") Where old, musty, tainted, stale or rancid fats are employed the finished product which may have a high acidity will not have the keeping qualities as that from clean, fresh, sound fats and produced under strict sanitary conditions. Unsterilized lard as neutral has limited keeping qualities and must be kept under refrigeration. Lard with moisture in it may decompose or become rancid. Clean, air tight containers, which exclude light, may delay chemical deterioration.

Lard for culinary purposes should be stored in a dry, cool place at a temperature not exceeding 36°F., as a high temperature favors the development of free fatty acids, rancidity and sourness. Old lard becomes rancid especially at temperatures of 70°F. or above or when the lard becomes softened. A dry storage place is essential, as moisture encourages the development of molds. If properly handled and stored under favorable storage conditions, refined lard should keep at least a year.

(e) Properties. Generally, lard may have the following properties: Melting point 30 to 45°C., softening point about 10 to 20° below the melting point, solidifying point 27.1 to 29.9°C., saponification value 193 to 199, refractive index at 40°C. 49 to 52, iodine value 50 to 70, specific gravity at 15°C. 0.934 to 0.938, free fatty acids maximum of 1 per cent (neutral lard 0 per cent), and moisture, 0.3 per cent maximum for prime steam and 0.1 per cent for kettle rendered lard.

(2) Lard Compound. Lard compound is a combination of lard and various other ingredients as vegetable or animal oils, fats or stearines. The usual requirements are that lard shall equal or exceed in amount the other ingredients used.

The ingredients used may or may not be bleached with Fuller's earth as described for refined prime steam lard. Oleo stearine may be bleached by sunlight. These products are melted, thoroughly mixed and cooled in an agitator tank or by chilling rolls as described for pure lard.

The usual ingredients used comprise the following:

Product	*Titre °C*
Prime Steam Lard	36–37
Lard Stearine	40–44
Oleo Stearine	49–51
Edible Tallow	42–44
Cotton Seed Oil	30–33

The titre of the finished compound may be calculated by multiplying the percentage of each ingredient used by its titre and then adding the results together. The average desired titre is 37°C. and for hot climates 38°C.

Lard compounds are filled into containers similar to those for lard. Usually the requirements for labeling include the name of contained ingredients in order of greatest amount, and declaration of artificial color if employed.

(3) Hydrogenated Lard. The titre of lard may be increased by hydrogenation whereby under certain conditions, unsaturated glycerides may be partly or completely saturated with hydrogen in the presence of heat and a catalytic agent, as finely divided nickel oxide. The catalytic agent later is removed. Any desired titre may be obtained up to that of hard tallow.

(4) Lard Products. Edible prime steam lard may be melted, seeded in a cooler at 45°F. and pressed cold in a press similar to that described for oleo stock under "a. Beef Fats," for the production of edible lard stearine used to "stiffen" lards, and lard oil which may be used by confectioners or used in inedible products. The amount and hardness of the stearine depends on the quality and hardness of the lard, the temperature of the pressing room and amount of pressure applied. This method is not practiced as much as it was in the past.

c. *Miscellaneous.* (1) Margarins. Certain animal and vegetable oils, with or without the addition of butter may be melted, made into an emulsion with milk, and chilled with cold water to produce a product simulating butter. Animal margarin (oleomargarin or butterine) is a mixture of choice animal and vegetable fats and oils with milk. Vegetable margarins are mixtures of vegetable oils with milk.

(a) Ingredients Used. *Animal Oils and Fats.* The animal oils or fats employed include neutral lard, oleo stock, oleo oil and oleo stearine as described above; and butter fat introduced as butter or in milk or cream. Oleo oil and neutral lard are desirable in high grade oleomargarins. Oleo oil used should have a bland, pleasant flavor and fine texture. Oleo stock is used in the lower grades. Mutton fats because of their undesirable flavor may be used only in small amounts in the lower grades. Stearines are used especially in bakers' shortening. Neutral lard is said to neutralize or to mask undesirable flavors in oleomargarin. Some brands of oleomargarin contains a small percentage of butter. (See Chapter XXII.)

Milk. Milk may be in the form of cream, sweet or sour, whole or skimmed milk, or buttermilk. A high grade milk is obtained and

pasteurized to inactivate objectionable bacteria. Boiling, if used would produce a burnt or cooked flavor which is undesirable. The pasteurized milk is inoculated with a "butter culture" of known lactic acid organisms and held about eight to twenty-four hours at 60 to 70°F. or until a certain acidity results in the milk (this varies from 0.45 to 0.70 per cent).

One procedure employed consisted of inoculating one quart of certified milk, incubating at 60 to 70°F. twenty-four hours, then adding 1 pint of this "starter" to 40 gallons of pasteurized milk, and when the desired acidity was obtained to hold the milk at 40 to 45°F. until used. The milk therefore is a medium for lactic acid fermentation which produces acidity and certain flavors, it may contain milk fat, and it is later used as an emulsifying agent with the oils.

Vegetable Oils. The vegetable oils include cocoanut, cottonseed, peanut, corn, sesame, palm, palm kernel, soya bean, kopok and wheat, most of which are refined and some, hydrogenated.

Crude vegetable oils may be expressed from oil bearing seeds or fruits by grinding and pressing cold with screw or hydraulic pressure, or extracted by means of steam or with solvents. As a rule such oils have undesirable odors and flavors, due to impurities, free fatty acids or rancidity, and are high in color, some being dark red. Refining may include the removal of free fatty acids, bleaching and deodorizing.

In the removal of free fatty acids, their percentage amount in a given oil is determined. The crude oil then is heated in a large tank under air or mechanical agitation, a definite amount of a standard solution of NaOH is added, agitation and heating continued for a period, agitation stopped and the oil allowed to settle. Flaky masses known as "foots" containing soaps, crude fibre, some coloring matter and other impurities settle to the bottom later to be used in soap manufacture, while the oil containing some coloring matter is siphoned into holding tanks. The oil may be bleached with 3 to 6 per cent of Fuller's earth or a mixture of Fuller's earth and bone black, and filtered as described for refined prime steam lard. The oil is light yellow in color to white but may contain undesirable natural and Fuller's earth flavors and odors. These are removed by deodorizing the oil through heating and washing with superheated steam under a high degree of vacuum, the completely refined oil being light yellow to white, bland to tasteless, odorless and practically free from water and crude fibre.

Cottonseed oil, deodorized without bleaching, known as "butter oil" may be used for the manufacture of a margarin having a high natural color.

Salt and Coloring Matter. The salt used in margarin manufacture generally is free from impurities and is sifted. Authorized coloring matter may be used to color margarins or is included in capsule form in packages containing the uncolored product. Commercially, the Federal tax on uncolored oleomargarin is $\frac{1}{4}$ cent per pound and for the colored product 10 cents per pound.

The product may be of a natural color due to tinted fats or oils employed, artificially colored with approved coloring matter or uncolored. Natural colored grades are made from oils which give a yellow color to the finished product as yellow oleo oil, yellow refined cottonseed oil, peanut oil, oleo stearine, butter, milk and salt. White oleomargarins are made from oils that give a white color, as oleo oil, neutral lard, oleo stearine, peanut oil, milk and salt. Vegetable margarin may be white. One brand consisted of peanut oil, cottonseed oil, hydrogenated cocoanut oil, milk and salt.

(b) Manufacture. The most important points in the manufacture of margarins are sanitation, quality of oils and other ingredients used, ripening of the milk and the employment of proper temperatures. All oils should be free from rancidity, acidity, moisture or other objectionable substances or properties. Should the milk contain too much acid it may curdle in the mixer and if too low in acidity it is said that the oils will not emulsify so well and that the finished product may "sour." Where improper temperatures are maintained the product may have an inferior body and quality.

Melting and Mixing. Usually the oils are received in tierces, taken to the melting room, placed separately into water jacketed kettles and heated to their optimum temperatures, under agitation. Neutral lard may be heated from 92 to 118°F., oleo oil from 92 to 110°F., oleo stearine 180°F., cottonseed oil 70 to 80°F., and peanut oil 65°F. Definite amounts of heated oils are strained and drawn into a scale tank and mixed, or run into a mixing kettle under agitation, and then into the churn. Butter if used may be melted and mixed with the oils or added later at the worker. The milk at 65°F. may be weighed and run into the churn.

Churning. The churn may be double jacketed and equipped with agitators, or of the continuous type. Efficient churning or agitation is given the ingredients under certain temperatures until a satisfactory emulsion is obtained. The better grade of margarin may be churned in the jacketed churn eight to ten minutes at 75 to 85°F. while the lower grades ten to twenty minutes at 85 to 95°F. A proper emulsion is necessary to produce satisfactory crystallization.

Crystallization. After churning, the emulsion is released through a broad flat nozzle to flow on a slanting chute where it comes into contact with a cold filtered water spray which produces instant solidification and breaks up the fatty mass into granules. The chilled product is collected in a vat of cold water (35 to 42°F.) or in hard-maple trucks arranged so that drainage may take place. Instead of the direct cold water chilling a refrigerated revolving drum may be used.

Tempering. The trucks of margarin are placed into a "tempering" room at 85 to 90°F. over night for the lactic acid bacteria and flavors to develop. This room should be free from odors, which if present would be absorbed by the product.

Working. After maturing, the product is placed into a "worker" where salt is added and the mass kneaded to form a butter-like, coherent mass of smooth consistency and to expel the excess of moisture. The average moisture content of the finished product is 12 to 14 per cent. If butter is to be included in the product and has not been added to the heated oils, it may be added at the worker. From the oils to the finished margarin the yield is about 118 per cent including the increase due to salt and moisture.

Blending. The product may be passed through a "blender," a machine equipped with revolving paddles which are said to make an article of greater smoothness. If desired, artificial coloring may be added at this time.

(c) Packing. The margarin then is taken to the packing table and divided into prints. It is claimed by some operators that by placing the prints into a cooler at 40°F. for twenty-four hours a better flavor is produced. The prints are wrapped and packed into cartons or otherwise packed into tins, tubs or other containers. Prints, weighing 1, 2, 3, 5 and 10 pounds may be wrapped in parchment paper and these enclosed in cartons; or, "pats" of these weights may be wrapped in cheese cloth and packed in 10, 30 or 60 pound net tubs. These tubs may be coated with paraffin and lined with parchment paper.

A high grade oleomargarin has keeping qualities equivalent to those of butter. It should be kept under dry storage at a temperature not to exceed 45°F. and not allowed to become soft. It may be frozen to hold. As this product readily absorbs odors, it should not be stored in a recently painted cooler or in one in which the floor has been treated with tar, creosote or similar substance. It may be stored with sound butter, lard or lard substitutes. If possible, stocks should be renewed every thirty to sixty days.

(2) Substitutes for Lard. Lard substitutes consist of mixtures of animal and vegetable oils, hydrogenated vegetable oils, and animal or vegetable oils or fats. Substitutes composed purely of vegetable oils are considered because they may be classified as packing house products and a veterinarian called to inspect them.

(a) Mixtures. There are numerous mixtures of animal and vegetable oils of lard like consistency, some containing lard or lard stearine but mostly composed of refined, deodorized vegetable oils such as cottonseed, cocoanut, soya, peanut or corn oils, and a stiffening medium as oleo stearine or edible tallow.

During summer or for shipment to hot climates about 17 to 20 per cent of oleo stearine may be used and 80 to 83 per cent of vegetable oils. For winter weather 14 to 16 per cent of oleo stearine may be used and 84 to 86 per cent of vegetable oils.

The oils may or may not be bleached. Bleaching may occur before or after mixing the heated ingredients. After mixing in the batch tank the mixture is cooled quickly over a water roll, then over a refrigerated roll, the translucent mixture falling from the roll at 50 to 55°F. into a picker pan or trough where a revolving worm beats it into a white semi-solid mass. The product then is pumped immediately through a strainer into containers, as this product quickly becomes firm and semi-hard in the final package. Instead of cooling rolls an agitator tank may be employed. Such mixtures always have a pasty, varnish-like appearance and are not as white as lard.

Lard substitutes are filled into containers similar to those for lard. Usually the requirements for labelling include the names of contained ingredients in order of greatest amount and declaration of artificial color if employed.

Lard substitutes do not keep as well as lard and if possible stocks should be renewed every thirty days. Substitutes should be stored the same as lard.

(b) Hydrogenated Vegetable Oils. Vegetable oils may be hydrogenated in a manner similar to that described for lard; the linolenic and linoleic radicles first being saturated into the oleic series and these into a synthetic stearic series. The hydrogenation may be partial to a titre of the consistency of lard or complete so that a hard product with a melting point of 58 to 62°C. may be obtained. Oils hardened above the titre of lard may be blended with unhardened oils to form a shortening of lard like consistency. Completely hardened oils may be ground to flakes or to a powder to form "dry shortening" which may

be mixed with flour for dough making. Undesirable flavors and odors in vegetable oils may be removed by hydrogenation. Hydrogenation may change completely the nature of oils so that they do not respond to certain chemists tests.

(c) Cooking Oils. These include refined, deodorized vegetable oils as corn and cottonseed oils, which may or may not be bleached, also edible lard oil and rendered bone marrow.

(3) Salad Oils. These include olive, corn, cottonseed, peanut and other edible vegetable oils which have been refined and the stearines removed from the oil by filtration through coarse canvas filters at a low temperature and pressing of the resulting mass to collect the remaining fluid oil which should not become cloudy at 40°F.

"Winter" oils generally are those from which under cold temperatures the "stearine" has separated out and the soft oil siphoned off, while "summer" oils are those which have not been "wintered" or otherwise treated to separate out the stearines.

3. Veterinary Examinations. a. Scope. The veterinary examinations of rendered, edible meat products intended for troops begin with a consideration of the sanitary source of such products, include the soundness and selection of authorized, specified ingredients used, grading for quality, condition and amount; and the supervision of the sanitary requirements relating to handling, trimming, washing, chilling, hashing and melting of fats; the drawing off, settling, clarification, bleaching, filtering, seeding, pressing, cooling of melted oils; pasteurization and manufacture of "starter"; mixing; churning; crystallization; tempering; working; blending; filling of final packages; weighing; crimping; labeling; packing; strapping; or other manipulation; handling; storage; shipment; receipt and issue, with such re-inspections including Medical Department laboratory examinations as are required. There are considered also the sanitary location, construction, equipment and methods of operation of establishments and compartments involved as defined in Army Regulations (See Chapter III, Handbook) and the national and state pure food laws regarding authorized ingredients, qualification of terms and labeling.

b. Inspections prior to Purchase. The inspections prior to purchase of rendered, edible meat products are the examinations made during their manufacture or when such products are offered for sale to the Government at purchasing points or in the field and include examinations for sanitation and soundness. In any event the inspecting veterinary or medical officer should be informed a sufficient length of time in

advance when and where products are to be prepared and every opportunity and facility should be furnished the veterinarian for the proper inspection of all products. The primary inspection of rendered, edible meat products from sanitary and specification standpoints cannot always be made at destination or delivery. In order to insure their proper production in compliance with specifications and also their wholesomeness, a sanitary veterinary supervision should be given their manufacture at the factory. In the event it is necessary to purchase the finished product, the sanitary production should be indicated by the presence of the standard markings of an official and competent sanitary inspection agency on the unopened package, however, a further sanitary organoleptic re-inspection is required to be supplemented when deemed necessary, by Medical Department laboratory examinations.

(1) Sanitation. All hashing machines, trucks, melting kettles, tanks, rolls, pipes, agitators, or other containers or appliances should be thoroughly cleansed and free from rust or dirt. Seeding vats should be cleansed thoroughly and steamed. Filter press cloths should be fresh and clean. Pipes used to convey different kinds of lards or compounds should be arranged to preserve the identity of each kind. Pumps, pipes, conductors, and fittings used to conduct milk or cream should be of sanitary construction with smooth surfaces of noncorrosive material, or coated with nickel, tin, or other approved substance, and easily cleaned. Receptacles into which lard or compound is drawn for cooling or storage should be clean and free from moisture. Cans should be properly cleaned and absolutely dry when filled.

(2) Products. (a) Ingredients Used. These in general are discussed under 1 and 2 above. Fats, oils and other ingredients entering into products intended for troops should be given both a sanitary and a specification inspection by an Army veterinarian. The nature, source, handling, and sanitary condition of all ingredients should be investigated.

Fats to be rendered should be examined for quality, cleanliness and freedom from offensive odors, contamination, blood, inedible material, sourness, or rancidity. Butter to be used in the manufacture of oleomargarin should be made from products pasteurized at 145°F., or above, for at least thirty minutes; or a momentary temperature of 180°F. as shown by accurate standard thermometers. The butter should be of good quality; firm, uniform in color, sweet and clean and should have not more than a medium salt content. Samples of materials entering into products intended for troops, or of the finished products, when deemed necessary, should be submitted to a Medical Department laboratory for examination in accordance with Army Regulations.

(b) Preparation. *Lards.* The best quality of refined prime steam lard may be purchased for issue and the best quality of open kettle rendered lard for the sale's article. Fats used should be of sanitary origin, sound, fresh and as specified. Usually fat trimmed from viscera is excluded. The addition of 3 to 5 per cent of sound, edible lard stearine may be required for tropical climates. After settling has been completed, care should be exercised that water is not drawn with the lard from the tank. The finished product should be sound which includes purity, cleanliness and freedom from foreign odors, sourness and rancidity. All machinery, equipment and methods employed throughout should be sanitary and adequate. Properly embossed cans or other containers properly labeled, as specified should be clean and dry at filling. Weights should be checked carefully, and scales balanced at least four times each day at proper intervals. Cases as specified should have the required markings, and should be closed properly.

Selected samples in the final package should be retained by the veterinarian and examined for soundness and in compliance with specifications. The package should be examined for kind, size, construction, markings, lacquering if specified, and defects. Examination of the contents include sanitary defects in quality as indicated by color, odor, flavor, texture, and presence of adulteration, excess moisture, mold, rust, dirt or other substance. In inspecting lard in tierces, samples should be taken with a long trier. The samples should include the lard at the lowest point in the tierces. Lard may become rancid first at the bottom when moisture is present. Package samples are desirable, especially in 3 or 5 pound pails. Bottle samples are not so desirable. The place of inspection should be free from odors and should be provided with plenty of natural light. The inspection never should be conducted in tank rooms. Drafts of air should be avoided as delicate odors may be carried away and not detected. The age of the sample should be considered. See if a "summer top" is employed. Examine the top of the lard. Note degree of waviness, color, grain and freedom from debris. Note odor. Push the volar surface of a forefinger through the lard and note if the body is firm, resistant and pushing up on both sides of the finger, or rubbery, soft or oily. Warm some of the lard in the hands by brisk friction and while warm carefully note the odor. A trier may be used to obtain a sample to the bottom of the package. Note color, odor, flavor, texture and general appearance. Heat the sample pail of lard until the lard is liquid. Note odor, flavor, color and if free from

turbidity, suspended particles or sediment. Pour out the sample into another container and notice the interior of the final package.

The color of chilled lard should be uniform, white and characteristic of the class to which it belongs. Darkness indicates improper bleaching or a poor quality of fats used. Rancidity may show a yellowish or dark discoloration. The texture should be fine and smooth and not rubbery, weak, oily, or gritty. The grain should be characteristic. The odor and flavor should be neutral, characteristic, and not "hoggy," acrid, sour, rancid, or pertaining to sweet pickle fats, tallow, tank water, Fullers earth, scorching or mould. If a musty odor is present it should be determined if peculiar to the product or due to the room, packing or container. Odors are more pronounced on heating. As the result of improper storage conditions, fatty acids and rancidity may develop, which are detected by the odor or taste and sometimes by the color or smooth appearance. Only the upper part of a product may be rancid and the remainder sound, but sourness usually affects the entire contents of a container.

"Tank water sour" lard is lard containing tank water which has soured or decomposed. Such lard should be rejected outright. It is not advisable to accept lard which having been affected to a limited extent, has been treated to remove tank water sourness, as by heating, cooking, repeated washing and agitation with clean hot water, settling and drying.

Adulterations may consist of oils such as arachis, corn, cottonseed, cocoanut and sesame oil and edible tallow. Adulterations, amount of free fatty acids, rancidity, moisture, iodine values and other indices may be determined by Medical Department examinations. The presence of a small amount of beef fat is difficult of detection.

Lard Substitutes. Lard substitutes containing animal fat may consist of a mixture of pure, sound, refined deodorized cottonseed oil 80 to 85 per cent and prime oleo stearine 15 to 20 per cent or otherwise as specified. For tropical climates the greater amount of stearine may be required to keep the product firm at the high temperature. The finished product should be sound and free from sanitary defects as added water or other foreign material, sourness, rancidity, taint or foreign odor.

Properly embossed cans or other containers properly labeled as required should be clean and dry at filling. Weights should be checked carefully and scales balanced at least four times each day at proper intervals. Cases as specified should have the required markings, and should be closed properly.

Selected samples should be inspected along the same lines as described under "Lards" above. The color should be creamy white. Storage at a high temperature tends to separate out the stearine producing vaseline-like blotches. Rancidity usually ensues quickly. The odor should be neutral and not abnormal as due to improperly deodorized oils, rancidity or other defects. The flavor should be pleasant and characteristic. The texture should be smooth.

Vegetable shortening may consist of partially hydrogenated, carefully refined, sound, edible, vegetable oils free from unsoundnesses including rancidity, sourness, contaminations, added water, nickel or other catalytic agent, and offensive odors; that prepared by mixing 10 to 15 per cent of completely hydrogenated oils with unhardened oils, then chilled and beaten; or, otherwise as specified. Generally the oils employed may be cottonseed, peanut, cocoanut or other edible vegetable oil. When requested to make an inspection of vegetable shortening prior to purchase, the veterinarian should be guided by sanitary and procurement requirements and inspect along the same general lines as outlined for "Lards" above.

Oleomargarine. Two specifications under the date of 1919 stated in part as follows, however, in all events the current purchase requirements should be consulted by inspecting Army Veterinarians.

> To be of the best quality, uncolored. To be made from sweet, clean oleo oil, neutral lard, cream, or milk and butter, salt and vegetable oil, the latter to be choice peanut oil or refined cottonseed oil and to be not more than 15 per cent of the mixture. The finished product shall be pure, sweet, clean, and free from any taint, sourness, rancidity, or foreign odor and shall contain not less than 10 per cent of butter fat and not less than 2.5 per cent nor more than 4 per cent of salt, and not more than 12 per cent of moisture.
>
> To be of the best quality, uncolored. To be made from sweet, clean oleo oil, No. 1 neutral lard, cream, or milk and butter, salt, and vegetable oil, the latter to be choice, peanut oil, or refined cottonseed oil. The butter to be incorporated in the mixture shall have a sweet, clean, fresh flavor, body shall be firm and uniform, color must not be streaked or mottled, and salt must not be higher than medium. The butter shall conform to the standards of purity established by the United States Department of Agriculture. The finished product shall be pure, sweet, clean, and free from any taint, sourness, rancidity, or foreign odor; shall contain not less than 8 per cent of butter fat, and not less than 2.5 per cent nor more than 4 per cent of salt, and not more than 12 per cent of moisture.
>
> In case of emergency or when the public interest may be best conserved, the purchase of oleomargarine with a lesser percentage of, or without, butter is authorized.

Veterinarians should inspect all ingredients as to soundness, quality, weights and other sanitary and specification requirements. He should

be present when butter for each batch is weighed and added to the other ingredients, determine the exact amounts used and the finished weight of each batch. From these two weights the exact percentage of butter entering into each batch may be determined. For sanitary and keeping quality reasons, hands should not come into contact with oleomargarine at any stage of its manufacture or packing. Cans, tubs, prints or other containers as specified should be embossed or labeled properly, cleaned thoroughly, steamed (if practicable) and dried before packing. The construction, soldering and lacquering of cans should meet requirements. Sometimes tin plate, process lacquered on both sides before manufacture into the finished can, may be required. It is important that there are no untinned edges exposed on the inside of the cans, otherwise rusting and discoloration of the product may occur. Tins should be packed completely full and contain no air space.

Insides of tubs and kegs may be coated with paraffin, and lined with paper or otherwise as required. Weights should be checked carefully and scales kept balanced properly. Samples of the finished product should be selected for organoleptic and Medical Department laboratory inspections. Chemical analyses are made to determine if the moisture, salt, butter fat and vegetable oil content comply with all requirements. The veterinarian should be familiar with all Federal and State laws concerned.

The characteristics of sanitary oleomargarin generally are the same as that for butter (See Chapter XXII). Oleomargarin may lack color, have certain characteristics of flavor and odor, and have a salve-like appearance.

It is not always easy to detect the difference between the two substances and the following test may be used: When a small quantity of the product in a spoon is heated over a flame, effervescing or boiling over and turning brown are characteristics of butter but not of oleomargarin. However, such agents as egg yolk, cholesterol, yeast, malt extract, milk powder or casein may be added at manufacture to give oleomargarine foaming and browning properties upon heating.

Generally the higher grades of oleomargarin are low in cottonseed oil and high in butter, while the lower grades are highest in salt, high in cottonseed oil, and butter in small amount or absent. Palatability depends closely on the quality of oleo oil used, also other materials. The better grades contain a higher quality of neutral lard and oleo oil. The lower grades have a flat greasy flavor which may be masked to a large extent by salt. The salt content roughly may be estimated by

tasting. Ordinarily butter contains about 2 to 3 per cent of salt, a higher salt content is readily detected by tasting. When 3 to 5 per cent of salt is present a sharp flavor may be defined, while above 5 per cent it is strong. The color should be uniform and free from spots and streaks. The odor should simulate butter and should not be rancid, greasy or strong of lactic acid. A sample placed into the mouth should be pleasant and smooth and not grainy or sticky.

Cases, kegs, tubs or prints as specified should contain all required markings and should be closed properly.

c. Inspections on Receipt. This is conducted whenever or wherever rendered, edible meat products are accepted, along the same general lines as outlined under Chapter VIII for fresh meats. The sanitary examinations should be adequate. This inspection may include such re-examinations for quality, quantity, containers and markings as required by purchasing officers at time of delivery before final acceptance.

Lards, lard compounds, substitutes for lard and oleomargarin should receive an organoleptic inspection on receipt, a sufficient number of containers as tubs and tins being opened and a sample taken from each with a trier or if in prints a sufficient number unwrapped and several cut open. Special attention should be given evidence of deterioration and such changes as rancidity, mold, undesirable odors and tastes, foreign coloring matters, and contaminations.

For Medical Department laboratory examinations the following as given by one author may serve as a guide:

> Great care in sampling is necessary in order that the sample may be fairly representative of the shipment. If a carload is to be sampled, at least ten packages should be opened and a small cylinder—2 or 3 inches long—taken from the center of each with a butter or cheese trier. These plugs should be placed at once in a tight, dry container such as a small Mason fruit jar, sample bottle with tight stopper or tin can with compression cover. In any case the closing of the container must be perfect so that moisture may not be lost from the sample before it reaches the chemist. At the chemical laboratory any separated water will be re-incorporated by warming to a creamy consistency and thoroughly mixing or beating after which the sample should be chilled in ice water.

d. Inspections During Storage. The inspection of rendered, edible meat products in storage is along the same general lines, where applicable, as outlined for fresh meats, Chapter VIII. These products should receive an organoleptic inspection from time to time in storage by opening a sufficient number of cans, tubs or prints, supplemented when necessary by Medical Department laboratory examinations. (See Sanitation under Chapter III.)

e. Inspections at Issue. The contents of each container if practicable should be examined at issue. (See inspection at issue of fresh meats, Chapter VIII.)

f. Action. (See "Action," Chapter VIII.) Lard, compounds, or oleomargarin found to be adulterated, rancid, sour, moldy, tainted, or otherwise unsound, unwholesome, or unfit for food purposes, should be rejected. At time of issue to troops, when rancidity is found affecting a limited quantity of a product and restricted to the upper part of the container, or when mold or other contamination is confined to the surface of a product, the removal of the rancid, moldy, or contaminated portion and the issue of the remainder may be recommended. When oleomargarin in prints becomes moldy, the mold is usually spread over the entire surface in small areas. In such case the entire print should be rejected.

CHAPTER XII

Products Inspection (continued)

F. SAUSAGES

1. General. *a. Defined.* Sausages are meat mixtures in bulk or placed into casings or other sausage coverings. The meat includes muscle tissue, fat and other connective tissues, blood and offal parts, in larger pieces or reduced to a fine state of comminution by cutting, chopping, grinding or mincing. Certain condimental, preservative and other edible substances may be incorporated. Sausages may be fresh, smoked, cooked, dried or otherwise prepared.

b. Ingredients Used. The selection of all raw materials entering into sausage manufacture is very important as a good quality of sausage depends on the employment of good materials. Fresh materials are essential. Old, mouldy, musty, slimy or unsound meats, cereals, or spices should not be used.

(1) Authorized. In addition to the sanitary requirements of the Surgeon General as defined in Army Regulations and relating to authorized ingredients used in sausages intended for troops and their labeling, Army veterinarians should be guided by national and state pure food requirements. In the event an inspection is made at purchase, the requirements of the purchasing authorities also should be consulted.

(a) Casings. *Natural.* The only natural or animal casings permitted for use as containers for sausage are those, from officially inspected and passed cattle, calves, sheep, goats and swine, and properly prepared. The ones principally used are derived from the small and large intestines, weasands and urinary bladders of cattle; small and large intestines, stomachs and urinary bladders of swine; and the small intestines and urinary bladders of sheep. The production of these casings has been discussed in Chapter VIII. It is important that the casings are properly cleaned and cured, that casing containers as tierces are clean, and that casings are not stored in a high temperature as they are liable to become slimy. Casings are shipped in tierces. Hog casings are purchased by the pound, sheep casings by the hank, beef rounds and middles by the set, and bungs by the piece. Sheep and hog casings because of their small calibre are the only natural casings used without being

turned. Hog bungs are turned inside out, fatted and turned back again. Beef rounds and middles are cut into various lengths, soaked, tested with air or water and turned by hand.

With the exception of hog and sheep casings, all animal casings as a rule are stuffed with the outer surface of the enteron or of the bladders, inside, next to the meat content.

All cured casings, just before being used are soaked in clear water at 80 to 90°F. to render them soft and pliable, then flushed out with fresh, warm water. If the water used is too hot, the casings later may tear or burst in the stuffing or smoking operation.

Casings should be carefully inspected to see that they are washed and thoroughly flushed with clean water, are suitable, clean, and free from nodules and excessive fat. Casings showing infestation with Oesophagostomum or other nodule-producing parasite, and weasands infested with the larvae of Hypoderma lineatum should be rejected, unless the infestation is slight when the portion affected only need be removed and rejected. All unclean, stained, sour or otherwise unsound casings should be excluded. Before beef casings are used as sausage containers, the mucous membrane of the ileocecal valve and the portion of the intestinal wall adjacent should be removed, or the casing so divided and tied that none of the surface covered with mucous membrane is actually used as a container. A few of the uses to which natural casings are put are as follows: Beef weasands are used as casings for high grade bolognas and summer sausages; beef rounds for bologna, summer sausages and liver and blood puddings; beef bungs for large bolognas, minced sausages, blood and tongue sausages, head and blood-head cheese and luncheon specialities; beef middles for bologna, luncheon specialties, blood sausage and summer sausages; and beef bladders for mortadella, minced sausage and luncheon specialties. Hog stomachs are used for head and blood-head cheese; hog bungs and hog middles for liver puddings and summer sausages; and hog casings for pork, liver, Polish and other smoked sausages. Sheep casings are used for Frankfort, Vienna style and fresh pork sausages. Bladders are used for minced sausages.

Artificial casings include parchment paper, corn husks and muslin bags which afterwards may be paraffined to prevent escape of moisture or the entrance of molds. Cartons and other containers also may be used for sausages.

(b) Meats. In the production of sausage or other prepared product intended for troops, there should be used only sound, wholesale cuts,

trimmings, offal parts, blood or other meat products derived from recognized food animals which have passed the required veterinary antemortem, portmortem and products inspections in accordance with Army Regulations, which bear the inspection legend of a prescribed official inspection agency and which subsequent to production have been handled and stored properly under strict sanitary conditions. Such products may be fresh unchilled, chilled, frozen, cooked, cured or otherwise prepared. Sausages made from frozen meats lack the quality and flavor as is found in those prepared from fresh or chilled meats.

Sausage affords an outlet for numerous edible products which otherwise would not be disposed of advantageously.

About one-third of the edible portions of carcasses of swine and cattle are made into sausage. Veal is employed to a limited extent while mutton with its distinctive flavor is seldom used.

The meat from old bulls representing about 73 per cent of the dressed weight, commercially is especially desirable because of its ability to absorb and retain added water (so-called binding power), being able to absorb when chopped fresh, 70 to 100 per cent of its weight of water, producing a cohesive mass. Meat from thin cows representing about 65 per cent of the dressed weight, having moist, flabby fibres is not capable of absorbing more than 60 per cent of water. Boneless beef as cheeks, chucks and shanks (with more gelatin) have good binding qualities. Fresh, hot beef has greater binding qualities than chilled beef and lean meat more than fat meat.

For pork, large lean pieces from the shoulder and cheeks have the best binding qualities. The binding qualities of pork are increased by salting and turning.

When lean meat with good binding properties is used the resultant product will hold together well, have a bright attractive appearance and show a smooth, even, non-friable surface when cut.

The higher grades of sausage contain no offal meats while the lower grades may contain a large proportion of them. Ordinarily not more than 30 per cent of meats with poor binding qualities as lips, tripe, hearts and similar offal parts are used commercially in sausages. Their use in excess would produce a friable product with a gray appearance, and because of their high water content there would be a considerable loss in weight during smoking and cooking.

For restrictions imposed on pork products customarily eaten without cooking see Chapter VIII, "Pork Trimmings."

Blood should not be used for food purposes unless it is fresh, sound, derived from animals free from disease and is collected and handled in such a manner as to prevent contamination. (See Chapter VIII, "Cattle-Offal.")

The grades of beef and pork trimmings are discussed under Chapter VIII.

(c) Water. The pure food restrictions for water generally are that water or ice should not be added to sausage except to facilitate chopping, grinding, or mixing and in such cases should not exceed 3 per cent, except, smoked or cooked sausages, such as Frankfort, Vienna or Bologna style, may contain more than 3 per cent added water, but not in excess of an amount necessary to make the product palatable. It is not intended that unlimited quantities of water are to be added to such sausages, but only sufficient to compensate unavoidable losses due to smoking and cooking. If more water than is normal to fresh meat is contained in the finished product, it is considered an adulteration.

Water or ice is added to minced meat to prepare a meat mass of proper consistency to facilitate its injection into thin-walled casings; to render sausages coherent, homogeneous, non-friable and juicy; and to offset losses due to preparation. Sausages manufactured without the addition of water are dry, friable, hard, tough and less palatable. The amount of water or ice added to some sausages averages about 24 per cent. Water or ice is added little by little during the chopping or cutting operation, if too much is added at a time the meat mass may become soggy, doughy, mushy and solid.

Where a quantity of water is used as in sausages intended for immediate consumption, their prolonged keeping produces a progressively unsightly appearance due to evaporation of moisture. During the processes of smoking and drying much, if not all the added water may be evaporated.

Dry or summer sausage is prepared without the addition of any water or ice.

(d) Spices. Authorized spices and condimental substances are discussed in Chapters VII and IX. The principal spices employed to give flavors to sausages include black, white, cayenne and paprika peppers; sage, allspice, cinnamon, cloves, caraway, coriander, mace, marjoram, garlic, onions, vinegar, sugar, salt and wood smoke. Condiments should be pure, well balanced, and properly and freshly ground to retain flavors. The inspection of spices for insect larvae should be conducted in a strong, bright light.

(e) Preservatives. Authorized preservatives are discussed in Chapters VII and IX. Salt is used as a curing agent, and saltpetre to impart a red color. If more than 2 to 3 ounces of saltpetre per 100 pounds of meat is used in curing sausage meat, after a time the meat becomes spongy, porous and pitted due to NO and N_2 gases formed and the meat contains a pungent odor and flavor which is sometimes desired by epicures. When benzoate of soda is used, its presence and amount should be shown on the label, on the true container, or on the sausage casing, if sufficiently large.

(f) Cereals. Usually 2 per cent is the maximum amount of cereal permitted in a product labeled, "Sausage," it being necessary to show the presence of cereal in a sausage, on the brand or sausage. Cereal sometimes is added to sausages to act as a cheap filler and binder. Cereals with over 9 per cent water content, tend to take on foreign flavors. Potato and bean flours are not classed as cereals and when used in sausage should be stated on the brand or label. Flours should be free from off flavors, mustiness and insect larvae or other vermin. During storage, flours and cereals should be protected against vermin infestation.

(g) Gelatin. Usually when gelatin not to exceed 5 per cent is used, its presence should be shown on labels as, "Gelatin Added," and if it exceeds 5 per cent, it should be part of the name.

(h) Milk. Milk used in the preparation of sausages should comply with all sanitary requirements. (See Chapter XVII.) Approved, fresh, whole or skimmed milk; desiccated skimmed milk; malted milk or similar substance when used, should not result in an excess of 3 per cent added moisture in unsmoked or uncooked sausage or in excess to the quantity necessary to make smoked or cooked sausages palatable. (See "(c) Water" above.)

(i) Dyes. Large packers seldom use casing dyes. Harmless, approved dyes may be used to color casings provided the dye does not penetrate the casing and color any of the meat contents and when their presence is shown on the casing or label in a prominent place contiguous to the name. Cloth casings first should be coated with uncolored paraffin before being dyed. When dyes are used, sausages should be examined to see that the dye has not colored any of the meat products within the casings. Water on dyes should be changed daily. Authorized dyes are discussed in Chapter VII.

(j) Labeling. Authorized branding inks and methods of labeling as fixed by Army Regulations are discussed in Chapter VII.

When water, cereal, benzoate of soda, milk, or other approved substances are added to sausage, or the casings of such are artificially colored, the markings should be placed on the casings also the package. When ingredients contained in approved animal casings smaller than the ordinary ring variety are packed in cartons not over 10 pounds net and containing a single kind of product, the markings may be omitted from the casings provided the cartons are properly labeled.

(2) Unauthorized. In general, unauthorized ingredients are discussed in Chapters VII and IX. Before standardization and enforcement of pure food laws, sausages were heavily loaded with cereals and other binders or fillers to give bulk, and with preservatives to prevent souring; and were given little or no smoking or cooking thus to keep down shrinkage. To stimulate the color, flavor and gloss of smoking, some sausages were dipped in solutions of oil of smoke, dyes, and varnish. Dyeing was also used by unscrupulous concerns to disguise decomposed meats and to improve their color. Oxide of iron and aniline dyes were used as well as sulphite of soda, salicylic and boric acids and borax.

Commercially, certain otherwise unauthorized preservatives are used on export products when the proportions and kinds do not conflict with laws of the country to which they are to be shipped.

c. Classification. Sausages are designated as those for quick consumption and those intended for storage over a long period of time and include fresh, smoked, cooked and dry or summer, meat sausages; blood sausages; white sausages or puddings; and jelly sausages. For the purpose of this text there will be considered the following sausages; fresh, smoked and cooked, and dry or summer. Certain miscellaneous products also are included.

2. Commercial Manufacture. The methods of manufacture of the various kinds of sausages are too numerous and complicated to discuss except briefly. In the sausage rooms an effort is made to produce good, wholesome, smooth finished products of good color, flavor and texture from a heterogeneous assembly of meat products and other ingredients through their proper combination and manufacture. Sanitation is a most important item as well as the soundness, quality and sanitary handling of ingredients, to prevent as much as possible the dissemination of microörganisms throughout the hashed meat resulting in products dangerous to health or subject to more rapid decomposition. The machinery, equipment and implements should be thoroughly cleaned after each day's work, and the machinery oiled. Stuffers, choppers,

mixers, trucks, tierces and other apparatus should be sanitary and clean. (See Chapter III.) Plenty of cooler space for proper chilling is desirable.

Usually 2 or more grades of each kind of sausage are made by each establishment depending on the materials and methods used.

a. Fresh Sausages. This includes fresh pork sausage, pork and beef mixtures, hamburger and bockwurst. The raw materials are not cured, neither are curing ingredients used in their manufacture, therefore their keeping qualities are limited and such sausages should be kept under refrigeration. The meat is run through an enterprise grinder or a chopper, then through a mixer where spices are added. The sausage may be sold in bulk, made into patties and packed into paper-lined cartons, stuffed into hog or sheep casings or canned. This sausage is intended to be cooked before being eaten.

The better grade of fresh pork sausage is made exclusively from pork, as trimmings, trimmed shoulders, and back fat, while in the lower grades, hog tripe, other offal parts and cracklings also may be used. Three per cent is the desirable upper limit for water when added. Water does not improve the keeping properties or quality of the sausage but is used to facilitate chopping, grinding, mixing or stuffing. Pepper, salt, sage and nutmeg are the principal spices used. When stuffed into hog casings, the sausage may be double linked, all ends of casings tied and scrap ends removed, then hung in a chill room at 32–36°F. to chill and dry. The chill room should be dry and electric fans used if necessary to facilitate air circulation. Some trade requires a fresh pork sausage which has received a light smoke.

Imitations resembling pork sausage made from meats, cereals spices and water and stuffed into casings are put out under certain trade names.

b. Smoked and Cooked Sausages. Smoked and cooked sausages include Frankfort, weiner, Bologna, Vienna, luncheon, liver, tongue and blood style sausages; liver and blood puddings; head and blood-head cheese; veal loaf and others made from cured meats and other ingredients stuffed into casings, smoked, cooked, canned or otherwise prepared. These sausages are ready for consumption without culinary cooking, have better keeping qualities than fresh sausages and may be kept up to two weeks under ordinary refrigerator storage.

(1) Curing of Meats. The dry and pickle curing of meats used in sausage manufacture have been described in Chapter IX. All fresh meats used should be chilled (if frozen they should be defrosted) and

then wholly or partially cured before smoking, otherwise the high, sustained heat of smoking would tend to cause more or less rapid decomposition due to microörganisms. (An exception to this may occur where cooked, fresh meats are used in the production of smoked, liver sausage).

All coarsely chopped meats should be cured before the sausage is stuffed or made. No. 3 or extra lean chilled trimmings may be thoroughly mixed with salt and saltpetre and 80° pickle and packed about 360 pounds in an open headed tierce, or in trucks and cured about five to eight days at 37 to 39°F. Meat may be coarsely ground in an enterprise grinder and cured the same as for No. 3 trimmings. By the emulsion method, the meat may be run through an enterprise grinder then chopped in a Buffalo or silent cutter with ice, salt and saltpetre. The ice keeps the temperature of the meat down. The chopped meat is then placed on racks, trays or in trucks to cure twelve to forty-eight hours. For finely chopped meats as used in Frankforts and bologna the curing agents and spices may be incorporated in the chopper, the mixture stuffed into casings, hung in a cooler twelve to eighteen hours, then "sweated" at room temperature four to six hours, before smoking.

Meat cured at too high a temperature or kept too long in the curing (spreading) room may become gassy, sour, mouldy or otherwise spoiled.

For certain cooked sausages as head cheese, liver and blood sausage, a large per cent of meat products are used, some of which are first cooked in water before being chopped or ground.

(2) Stuffing and Preparation for Smoke. After curing, the meat is removed from the cooler and run through a silent cutter or a mixer where other ingredients are added. After thorough mixing, the sausage meat or mass is placed into a hand or power stuffer, then stuffed into casings, cans or other containers. (See Chapter X.)

Properly prepared casings are drawn over the stuffer nozzle, the vent is opened and the meat mixture is forced into the casings. To eliminate air pockets between the casings and the meat, the casings may be pricked with a small, sharp pointed instrument, as an awl.

After stuffing, the sausage is linked or tied, with all scrap casing ends removed, or cut into lengths. Large sausages may be wound and tied in several places. If made from cured meats, the sausages are then placed on smoke sticks, hung on smoke trees, allowed to dry a few minutes and then run into the smoke house. If prepared from uncured meats, sausages should first undergo curing as outlined above, before smoking.

(3) Smoking. Sausage smoke houses are similar to the ordinary meat smoke houses but usually are smaller and with the fire closer to the product. Smoke is produced by burning hickory or other hardwood and sawdust, and heat by burning wood or gas or by steam pipes. The smoke house should be warm at the time sausages are placed into smoke. Sausages may be hung on smoke trees, on a sliding carriage or on a cage, and run into the smoke house where they are smoked one-half to four hours at 70 to 180°F. Some sausages are finished at 220°F.

SMOKING TEMPERATURES FOR SAUSAGE
(Davis-Wilder)

KIND OF SAUSAGE	TIME	TEMPERATURE
	hours	*°F.*
Long Bologna	3	145 to 150
Large Bologna	3	145 to 150
Round Bologna	2	135 to 140
Bag Bologna	1	140 to 145
Bologna in weasands	4	185
Knoblauch	1½	130
Leona Bologna long	3	145
Leona Bologna large	3	145
Regular Frankfurts	2½ to 3	130 to 135
Vienna Frankfurts	3	140 to 145
High grade Frankfurts	3 to 3½	150 to 160
Blood	12	65 to 70
Tongue	12	65 to 70
Liver	1 to 1½	110 to 120
Polish	3 to 3½	150 to 160
Minced ham	3 to 3½	135
Berlin	5	130 to 140
Cooked pressed ham	5	130 to 140
Cottage ham	32	120
Boneless ham	48	80

When sufficiently smoked the sausages are removed. It may be noticed that they appear wrinkled and shrunken. This is due to a loss of moisture during the smoking operation. This loss depends on temperatures maintained, time, amount of water added to the sausage, nature of ingredients used and amount of exposed surface. This shrinkage in some instances may almost equal the amount of water added.

Shrinkage of Domestic Sausage in Smoke
(Davis-Wilder)

KIND OF SAUSAGE	PER CENT OF SHRINKAGE
Long Bologna	8½–11
Large Bologna	7¼–10
Round Bologna	8½–11
Bag Bologna	6– 9
Bologna in weasands	6– 9
Knoblauch	10–11
Leona, long	10–13
Leona, large	10–12
Regular Frankfurts	11–13½
Vienna Frankfurts	19–22
High grade frankfurts	18–20
Regular pork	2– 4
Little pig pork	2– 4
High grade breakfast	1½– 3
Blood	31–36
Liver	12–14
Tongue	38–40
Polish	12–14
Head cheese	39–42
Luncheon beef	47–50
Boneless pigs feet	22–25
Minced ham	6– 9
Berlin ham	22–27
Cooked pressed ham	15–17

(4) Cooking. To overcome the wrinkled condition of sausages coming from smoke and to inactivate microörganisms and live trichinae, the sausages are cooked in water in cooking boxes or vats, fifteen minutes to five hours at 140 to 180°F. It is necessary to obtain a temperature of at least 137°F. throughout the product during this operation, to destroy trichinae. The steam arising from cooking vats should be disposed of properly by ventilator hoods or other arrangements. (See page 439.)

(5) Washing and Chilling. After cooking, the sausages are hung on trees or racks and washed or sprayed with hot water to remove the grease from cooking. The contents within the casings have expanded and the sausages are full, plump and smooth. To prevent further shrinkage of the sausage with wrinkling, they are now chilled quickly with a cold water spray which fixes, sets or shrinks the casing so that when thoroughly chilled the sausage will have a smooth appearance.

(6) Hanging. After spraying with cold water the sausages may be hung or spaced in a dry chill room where they are chilled at 38 to 45°F. Fans may be employed to aid dryness through air circulation. Here they are branded and held until packed. If the cooler is maintained at too cold a temperature, the products may "sweat" when removed therefrom.

(7) Miscellaneous. Frankfort and Vienna style sausages contain finely chopped meats, it being necessary in the chopping operation to watch carefully that a proper amount of ice or ice water is used in the

Cooking Schedule for Sausage

(Davis-Wilder)

KIND OF SAUSAGE	TIME		TEMPERATURE
	hours	*minutes*	*°F.*
Long Bologna		30	160
Large Bologna	2		160
Round Bologna		20	155
Bag Bologna	2		160
Bologna in weasands		45	155
Knoblauch		20	160
Leona Bologna long		40	155
Leona Bologna large	2		160
Regular Frankfurts		7	160
Vienna Frankfurts		7	160
High grade Frankfurts		7	160
Blood	2		200
Tongue	2		200
Liver		30	160
Minced ham	4		150
Berlin ham	2		170
Head cheese		45	180
Cooked pressed ham	2	30	180

silent cutter to prevent the meat attaining a high temperature and souring. Frankfort and wiener style sausages may contain 50 to 60 per cent of beef and 40 to 50 per cent of pork. Another grade may contain about 30 per cent beef, 30 per cent pork and 40 per cent meat products. Frankfort style sausages are stuffed into hog or sheep casings and Vienna style sausages into sheep casings and arranged in links about 20 inches long. Later, these links may be subdivided into sections just long enough to fill cans. Bologna is not as finely chopped as Frankfort style sausage and may have large pieces of fat added,

then stuffed into beef weasands, rounds, bungs, middles or bladders. One good grade of bologna consists of 75 per cent beef, 15 per cent pork and 10 per cent of back fat. Luncheon specialties may contain large pieces of lean pork and finely chopped beef, stuffed into beef bungs or bladders and smoked, or stuffed into canvas bags which are not smoked but which after cooking and chilling are paraffined. Liver sausage of a high grade may be prepared wholly from fresh, cooked meat products. Blood and liver sausages, head cheese, souse, jellied tongues, boneless pigs' feet, and certain other products may not be smoked. Certain cooked sausages are placed into pans or moulds and chilled.

c. Dry Sausages. Dry or summer sausages are intended for consumption without cooking (See trichina rulings—Chapter VIII, "Pork Trimmings") and are prepared so that they may be kept in a good state of preservation over a long period of time. These sausages are prepared according to German, French, Italian, Polish, Swedish and other styles, the general methods of manufacture being the same with variations existing in ingredients, spicing, casings, smoking and other methods. French and Italians prefer unsmoked dry sausages. Seldom are flours or cereals added. Water is not added as the keeping qualities of summer sausage depend on its state of dryness. The kinds of dry sausages are numerous, some of the common ones being salami, mettwurst, cervelat, D'Arles, frizzes, pepperoni, mortadella, Holsteiner and milano.

(1) Ingredients Used. The highest quality of meat products, especially beef and pork (used within seventy-two hours after being cut) are required. Usually such products as beef trimmings, boneless chucks, shank meat, hanging tenderloins, cheeks and weasands; sheep hearts; and pork head meat, lean and regular trimmings, butts and large lean pieces of pork, are used. Too much fat pork used with beef affects its binding qualities. In low grade dry sausage there may be used beef and hog hearts, tripe and ox lips.

All pork used should be treated as prescribed under trichinae rulings. Frozen meats must be handled with considerable care as they tend to give a dull color to the finished product. The temperature and time prescribed for smoked dry sausages in these rulings usually are so great as to make the other methods preferred by some packers.

(2) Chopping. All meats are chopped and ground, during which operation spices and curing agents usually are added. The beef generally is run through an enterprise grinder, then either rocked, or chopped

in a silent cutter. The cheaper grades of meat may be run through a silent cutter which is a time saver (usually cutting the meat in two to five minutes) but with a more or less torn condition of the meat which will show an uneven surface on the cut section of the finished sausage. The better quality of meats are rocker chopped. This requires a longer time (usually fifteen minutes to half an hour), but the cut surface of the finished product is smooth and even, with few shreds. The spices, curing agents and finally the pork ingredients are added to the chopper. After rocker chopping, the mixture may be chopped in a silent cutter for varying periods of time depending on the fineness desired. Salamis are coarsely ground while cervelat is finely ground.

(3) Curing. The chopped mixture is next taken to a "spread" room or cooler maintained at 40 to 50°F. Here it is spread on trays, pans or shelves or in trucks, usually not over 15 inches thick, and allowed to cure two to five days. The surface of the meat becomes dark gray during this time but this has no sanitary significance provided sanitary conditions obtain.

(4) Stuffing. After curing, the meat may or may not be run through a mixer, then placed into a stuffer and stuffed into casings. The casings are pricked when necessary at time of stuffing to allow the escape of air and thus prevent the formation of "blisters" and the later development of green or gray spots in the sausage. All sausages should be stuffed tightly.

(5) Smoking. Dry sausage may or may not be smoked. All Italian dry sausages are not smoked. Sausage to be smoked, first may be hung twenty-four hours in a "green" dry room to prevent surface streaks from forming on the casings. In the green room the sausages are changed when necessary, to insure uniform drying.

Considerable care must be exercised in smoking dry sausage as it is only partially, if at all cured when placed into the smoke house. A smouldering fire of oak, hard maple, hickory or sawdust alone is often employed twenty-four to forty-eight hours. The object is to produce a cool smoke of 70 to 80°F. which will keep the smoke house filled. A blazing fire is not desired. Temperatures above 90°F. if maintained over too long a time may cause sourness and hasten rancidity, while too low a temperature or too dense a smoke will result in unsatisfactory drying and a "smoky ring" on sausages.

(6) Drying. When removed from the smoke house, sausages should be protected from rapid cooling as from drafts, otherwise the sausages may collapse or flatten and contain deep wrinkles or have a rough

exterior. After smoking, sausages are hung in a drying room which should be maintained at a uniform temperature of 48°F. with a possible range of 46 to 53°F. Good ventilation is necessary but drafts should be avoided. Sections may be partitioned with burlap to prevent drafts. Sausages stuffed in hog bungs can withstand more draft than those enclosed in beef casings, so the latter may be hung near the center of the room. Rooms may be equipped with steam coils, windows, fans and a mechanical air conditioner to control temperatures and air circulation.

It is possible under the best of conditions to have finished dry sausages come out of the drying room relatively free from mold and of a good color. The extent of mold on casings depends on conditions of temperature, humidity, air circulation and the length of time. Sausages held for three months usually show a growth of mold. When the growth of mold is slight, the sausages may be wiped off, but when extensive a sausage washing machine employing hot water may be used to remove the mold. After such washing, certain sausages are rewrapped with twine by hand or by special machines for this purpose.

Dry sausage is marketed in 3 different weights: "New" sausage from ten to twenty-five days after smoke, "Medium Dry" thirty to sixty days, and "Dry" ninety days or over.

The shrinkage of dry sausage varies according to the length of time in the drying room, and may average as follows:—Capacola 35 per cent, Cervelat 25–40 per cent, Chorizos 45 per cent, Coppa 40 per cent, Farmer 40–45 per cent, Genoa 45 per cent, German Salami 42 per cent, Goteborg 42 per cent, Holsteiner 42–45 per cent, Leghorn 45 per cent, Lyon 42 per cent, Milano 40 per cent, Mortadella 25 per cent, Pepperoni 45 per cent and Roma 45 per cent.

d. Miscellaneous. (1) Cooked Meats. Cooked or boiled meats are rolled or pressed, boneless meats prepared from sweet pickle and smoked pork by boning, tying, removing surplus fat, cooking, smoking or other manipulation, and include boiled boneless hams, shoulders, cooked loin rolls and certain pig tongues.

(a) Boiled Hams. Hams for boiling or cooking purposes are from the heavier averages, either regular short cut hams weighing 12 to 30 pounds or skinned hams from 14 to 22 pounds. Hams may be selected from regular cure or given a special mild, or even a hard cure in addition to heavy pumping. Overcured and undercured hams are undesirable while newly cured hams are preferred. Selected hams should be sorted into uniform weight averages, as their average weight determines the

time of cooking, otherwise in a mixed lot smaller hams may be overcooked or larger hams undercooked. A trier inspection should be given all hams to eliminate any unsound. Usually the hams are soaked in water at 70 to 80°F. for three to five hours to remove the excess of salt. One packer soaked hams two minutes per day in cure, using water at 100-110°F. If skins are to remain on the hams, they may be branded at this time.

The skin may be lifted from the butt of the ham far enough towards the shank and the underlying surplus fat removed to an even thickness of $\frac{1}{2}$ to $\frac{3}{4}$ inches. The skin may be replaced or later partly so, or entirely removed and utilized in prime steam lard. The skin and fat shrink varies from $8\frac{1}{2}$ to 15 per cent.

The boning of the hams should be done properly to insure a finished product from which uniform slices can be obtained. The aitch and shank bones are removed and then the "body" bone. Care should be taken not to mutilate the ham or to remove too much meat with the bones. After boning, the scrap meat is replaced in the ham and the shank meat is folded in and sewed to give the boneless ham a better shape. The boning shrink is estimated as about $7\frac{1}{2}$ per cent and the boning and fat shrink 18 to 25 per cent.

The boneless ham may be smoked at this time prior to cooking or later after cooking. If smoked at this stage, they are hung in a smoke house, usually shank down and subjected to a sawdust smoke two to four hours at temperatures from 80 to 110°F.

In preparation for cooking, each unsmoked or smoked boneless ham is wrapped or bound with twine to make a compact package; tightly wrapped lengthwise in a clean canvas ham cloth and compressed tightly within a galvanized iron cylinder; or, unwrapped and pressed by hand, machine, air, steam or hydraulic pressure into round, oval, square or flat metal moulds using clamping plates with or without spring pressure. These metal moulds may be of galvanized iron or aluminum, and by their use ham pressing cloths are unnecessary. Hams are cooked, pressed in these moulds to give them compactness and form and to reduce fat shrinkage.

Bound or pressed hams may be cooked by the old vat method wherein the hams are placed into an open cooking vat, covered with water and cooked twenty-two to thirty minutes per pound or four to six and a half hours at 155 to 180°F. with a shrinkage of 20 to 40 per cent, cooled quickly by running cold water into the vat, placed into a cooler to chill, press cloths removed, the hams washed free from adherent surface fat with hot water and returned to the cooler.

Cooking cabinets may be employed wherein the pressed hams are cooked by means of steam vapors. Hams cooked by this method are very palatable, but the temperatures within the cooking box may vary at different levels.

Hams may be run into closed retorts, as canning retorts, water introduced and heat produced by live steam controlled by a thermostat. By this method, lower temperatures but longer periods of time are employed with shrinkages averaging from 10 to 18 per cent. One establishment cooks hams in round containers thirty-two minutes per pound at 160°F., and those in oval or flat containers thirty minutes per pound at 160°F. Cold water may be introduced into these retorts after cooking to chill the hams. The moulds are removed from the retorts, emptied and then washed by hand or in a mechanical washer, for the next batch of hams.

If the hams are unsmoked, they may or may not be smoked at this time. Those to be smoked may be laid on racks in a smoke house and subjected to a light smoke of one hour, starting with a temperature of 110°F. and ending at about 150°F.

Finished, boneless hams are placed into a cooler, spaced on clean racks and held for about three days to firm out properly. The quality of boiled hams depends principally on the curing, boning and cooking.

(b) Boiled Shoulders. Picnic shoulders ranging from 8 to 16 pounds may be selected, partly or entirely boned, wound and cooked similar to boiled hams, with a shrinkage of 30 to 35 per cent.

(c) Cooked Loin Rolls. Fresh pork loins ranging from 16 to 24 pounds may be boned out, trimmed, tied together, cured, cooked and sold as loin rolls. In boning pork loins, care should be exercised not to mutilate them. The boning and fat shrink may average 50 to 60 per cent. After boning, 2, 3, or 4 boneless loins may be placed together and securely wrapped or bound with strong twine to form a roll about 16 to 30 inches in length and 4 inches in thickness. Wrapping should be done on the same day they are cut. Rolls should be uniform in size, not too tightly wound so as to interfere with curing and with no air spaces remaining in the center of the roll. Wrapping may be done by hand or machine with strings spaced about $\frac{3}{4}$ inch apart.

Loin rolls may be dry cured in tierces thirty to thirty-five days or sweet pickle cured in tierces or vats using about $5\frac{1}{4}$ gallons of pickle per 100 pounds of meat and cured in twenty to thirty days.

Instead of treating loins as described above, a boneless loin may be cut in-two and the two pieces placed into a beef bung, wrapped with

strong twine, packed 300 pounds to a tierce, tierce headed up, and cured in sweet pickle thirty days.

Cured loin rolls may be hung on trees and smoked three to five hours at 130 to 160°F., then cooked in water at 155 to 160°F. for two to four hours according to weight.

Loin rolls to be prepared without cooking are discussed under (2).

(d) Pig Tongues. Cured pig tongues may be cooked in second pickle two hours at 180°F., trimmed with gullets removed, placed into canvas bags, cooked two hours longer at 180°F., cooled, dipped into paraffin and pressed. For jelly tongues and tongue sausage the product may be cooked two and a half hours in plain water at 180°F.

(2) Pork Products under Trichina Rulings. These include miscellaneous pork products as pork butts for capacola, and coppa; boneless hams; butts; pork and beef mixtures; loin rolls and others which are eaten without cooking, all of which should be produced under the requirements as discussed under Chapter VIII, "Pork Trimmings" which relate to trichinae.

3. Packing, Storage and Shipment. Sausages may be wrapped and packed in various paper wrappings, cartons, boxes, glass containers and in cans (See Chapter X). Fresh sausage may be delivered in bulk, in patty or link form. It should be stored under refrigeration and not held more than one week. Smoked and cooked sausages may be held two weeks under good, cool, dry storage. When held in a moist room or over a period of time they become slimy or mouldy. When very slight, without any breaks occuring in the casing or involvement of the contents, the sausages may be freed from the mold or slime by wiping or proper washing before using. For Army consumption such sausages are undesirable. To hold smoked or cooked sausages more than two weeks would require their freezing.

Mold on summer or dry sausages is not so important if the meat is not involved. To hold dry sausages over a long period they may be packed in boxes and held in dry storage at 36°F. Before shipping, they should be removed from the boxes, and the surfaces thoroughly wiped before repacking. Dry sausages should not be subjected to freezing temperatures or they will become gray, extending from a gray rim next the casing or until all parts become gray depending on the extent of frost penetration.

Boiled hams which have been firmed out by thorough chilling should be given a trier inspection, especially in the shank where decompositions, when they occur, are most frequent. Sound hams may be branded

with the inspection legend and wrapped. Usually one layer of glassine paper is placed next to the meat, then as outside layer of parchment paper on which are placed the required labels and brands. Boiled hams may be kept in good, dry, cool storage two weeks. They should be stored where there is not so much air circulation as would dry the surface of the meat, and should be protected from flies. Moist storage is conducive of mouldering.

4. Veterinary Examinations. a. Scope. The veterinary examinations of sausages intended for troops including both sanitary and procurement inspections, begin with a consideration of the sanitary source of such products; include the selection of authorized, specified ingredients used, grading for quality, condition, trimming and amount; and the supervision of the sanitary requirements relating to freezing, defrosting, grinding or chopping, boning, trimming, mixing, curing, stuffing, wrapping, smoking, cooking, washing, chilling, drying, weighing, branding and labeling, or other manipulation, handling, storage, shipment, receipt and issue, with such reinspections as are required. There are considered also the sanitary location, construction, equipment and methods of operation of meat establishments involved as defined in Army Regulations (see Chapter III, Handbook); the special treatment of pork products customarily eaten without cooking; and the national and state pure food laws regarding authorized ingredients and labeling.

b. Inspection prior to Purchase. The inspections prior to purchase are the examinations made during manufacture or when sausages are offered for sale to the Government at purchasing points or in the field and include examinations for sanitation and soundness. In any event the inspecting veterinary or medical officer, should be informed a sufficient length of time in advance when and where products are to be prepared and every opportunity and facility should be furnished the veterinarian for the proper inspection of all products. The primary inspection of sausages from sanitary and specification standpoints cannot be made at destination or delivery. A correct opinion can hardly be formed regarding the fitness of sausages for consumption merely by just an examination of the finished product. In order to insure their being prepared from officially inspected and passed products and pure ingredients, in compliance with specifications and also their wholesomeness, a sanitary veterinary supervision should be given their manufacture at the factory. In the event it is necessary to purchase the finished product, the sanitary production should be indicated by

the presence of the standard markings of an official and competent sanitary inspection agency, however, a further sanitary organoleptic reinspection is required to be supplemented when deemed necessary, by Medical Department laboratory examinations. Veterinarians should be careful on such inspections regarding lower grade sausages or other products derived in whole or in part from meats or meat products from diseased or parasitized carcasses or parts, passed for sterilization. Usually this can be determined for products produced under official inspection in the United States, by an examination of the labeling or branding of the finished or wrapped product.

(1) Sanitation. The general sanitary requirements are discussed in Chapter III. Sausage compartments should be sanitarily located away from any inedible or other rooms from which objectionable odors might be absorbed by products. This would include stables, catch basins, hide cellars and tank, fertilizer, casing, dressing and toilet rooms. Toilets should be provided with towels and hot and cold running water facilities. Rooms in which sausage is hung should be dry and free from mustiness. Rooms should be protected from vermin, odors and vapors.

(a) Machinery and Equipment. All machinery and equipment as benches, tables, vats, trucks, containers, grinders, choppers, mixers, and stuffers should be of sanitary construction, readily cleaned, in good repair and maintained in a sanitary condition. After being used, all equipment should be thoroughly cleaned and given a veterinary sanitary inspection before again being used. All equipment should be examined for sanitation the first thing each morning. Sausage sticks may be cleaned in a washer. Sausage pans may be cleaned by hand with a soda solution then thoroughly rinsed with clean tap water. All machinery used in the preparation of meats with cereal added, before being used for sausage without cereal should be thoroughly cleaned. All grinders or other apparatus used for non-inspected meats should not be used for those intended for troops unless first placed into a safe, sanitary condition and approved by the inspecting veterinarian. Edible equipment should never come into contact with the floor or other contaminating substances, and edible containers should not be used for inedible products.

(b) Personnel. All personnel should be instructed in and should observe all sanitary requirements. Their outer clothing, person, hands and arms should be clean. They should be free from communicable diseases. Hands and fingers should be clean, especially underneath

and around the nails, and free from open cuts or wounds. In so far as practicable hands or arms should not come into contact with the products, and when such obtains should be thoroughly washed frequently.

(c) Methods. A supervisory, sanitary, veterinary inspection should be given all processes and manipulations.

(2) Products. (a) Ingredients Used. These in general are discussed under "1. General," above. Meats and other ingredients entering into products intended for troops should be given both a sanitary and a specification inspection by an Army Veterinarian. Ingredients should be fresh, clean, sanitary, wholesome, and sound, complying with all sanitary and purchase requirements. Samples of materials entering into products intended for troops, when deemed necessary, should be submitted to a Medical Department laboratory for examination in accordance with Army Regulations.

Meats. If unsound or questionable meat in small quantity is found in ground meat, the entire lot should be rejected, as it is impracticable to separate such out. Likewise any meat of questionable origin should be rejected. Frozen trimmings when used should be properly defrosted and free from scraps of paper. Any meat packed into a truck or other container while in a warm condition, should be looked on with suspicion as frequently such meat becomes gassy, sour or otherwise decomposed. Cured meats should be examined closely for mould or other deterioration. Specifications or other purchase requirements should be followed by the veterinarian making an inspection prior to purchase of Bologna, Frankfurter, and Vienna style sausages; fresh pork sausage; veal loaf or other sausage.

Pork. Pork used may be in the form of reasonably lean or regular pork trimmings. Frozen pork trimmings should not be used unless specified. When employed they should be defrosted properly in a chill room, carefully examined for soundness and quality before grinding or chopping and used without delay. All trimmings should be as fresh as possible, sound, clean, of a bright color and dry. Those which are unsound, slimy, sticky, old, contaminated or containing blood clots, hair, scurf, seeds, bony particles or other objectionable material should be excluded. The fat content should be white, firm and not oily. Cracklings, offal parts and head meats are undesirable for high grade sausages. The purchase requirements should be consulted as to kind and amounts of pork trimmings to be used in any particular contract, also an interpretation should be obtained from the purchasing quarter-

master as to what percentage of fat is desired in lean, regular or other pork trimmings used in any contract and thus avoid any disputes which may arise with the contractor. (See Pork Trimmings, Chapter VIII.) Regular pork trimmings generally contain 40 to 60 per cent fat; and No. 3, 10 to 30 per cent. Reasonably lean pork trimmings may contain 60 to 70 per cent lean.

For example, the following taken from specifications which have been used are quoted and amplified; however, in all instances the current purchase requirements should govern: In addition to other ingredients, 70 per cent lean and 30 per cent fat, strictly fresh, sound pork trimmings free from head and frozen trimmings, may be used for fresh pork sausage. Where more than 30 per cent of fat is contained in pork trimmings for canned pork sausage, an excessive amount of free fat is rendered out. Bologna may contain $22\frac{1}{2}$ to $27\frac{1}{2}$ per cent each of fresh regular and lean pork trimmings; Frankfurters 40 per cent reasonably lean fresh pork trimmings; Vienna style sausage 35 percent reasonably lean; and veal loaf 40 to 50 per cent of best quality, fresh, regular pork trimmings. From a practical standpoint it is thought that a better veal loaf is obtained where the pork element is reduced or entirely eliminated.

Beef. Any fresh beef derived from well nourished animals, bearing marks of prior official inspection and sound, may be used as "bologna beef." Meat should be well firmed out on chilling and not sloppy. Fat beef and plates which contain a high percentum of connective tissues are not desirable. Offal and head meats are undesirable in high grade sausages. Usually, well trimmed, boneless chucks from canner and cutter cattle, and lean trimmings are used. Frozen meat should not be used unless specified and then it should be properly thawed out and inspected before using. All beef used should be sound, clean, wholesome and free from contaminations, blood clots, gross connective tissues and other undesirable materials. The kind and amount of beef as specified should govern in any contract. For example, the following taken from specifications which have been used are given, but the current requirements should govern in each instance: In addition to other ingredients there may be used for Bologna 45 to 55 per cent of the best quality bologna beef; Frankfurters, 60 per cent, and Vienna style sausage 65 per cent.

Veal. The general remarks for beef apply to veal. For veal loaf, one requirement specified in addition to other ingredients, 50 to 60 per cent of the best quality of fresh, chilled veal, sound and free from defects, as listed for beef.

Casings. Barrels or tierces of casings should be inspected at the time they are opened, before any casings have been removed. Intestinal casings, except hog and sheep casings, are turned, fat side out and flushed with clean water and given a piece inspection. They should be from an approved source, clean, sanitary, suitable and free from sourness, slime, taint, contaminations and parasitic infestation. Usually, beef middles are the most unclean. Beef bungs containing nodules should be rejected. After inspection, the casings are again turned and flushed with clean water. Meat taken from stuffing tables for re-stuffing should be free from casings. Bladders should be heated with hot water, rubbed and examined for urinary odors.

Fresh pork sausage when required may be stuffed 8 links per pound in hog or wide sheep casings. In some events the links may be of such a length as will just fit the inside of specified cans. For Bologna, the best quality of beef middles may be required, and for Frankfurters, the best quality of sheep casings with not more than 8 links to the pound. For Vienna style sausage, usually the best quality of narrow sheep casings are used so that not less than 15 links or square cut lengths will weigh one pound. Hog casings because of their size and of breaking during processing, are not so desirable.

Flours, Cereals, Spices and Coloring Matter. Flours, cereals and spices should be examined in the hand under strong natural light for vermin. Larvae appear as small white spots, which, when subjected to light and the heat of the hand, soon become motile. Potato flour, cereals and similar substances should not be used unless specified. Veal loaf may be required in some instances to contain 3 per cent of fresh cracker crumbs as a binder. Usually, only pure, clean salt and spices are permitted. Black pepper when used in Vienna style sausage may lower the appearance of the finished sausage. Coloring matters usually are prohibited.

Water. Water and ice used in products and for cooking or washing purposes should comply with the sanitary requirements of the Surgeon General. (See "Manufacture of Ice," Chapter VIII.) Ice should not be dragged across, stored, cleaned or washed on, floors. Water used should not exceed the prescribed amounts. When excessive amounts are used shrinkage in the size of the sausages with wrinkling of casings may occur in smoke. For Bologna the water used in chopping usually does not exceed 20 pounds per hundred pounds of meat. Usually the addition of water to fresh pork sausage for the Army is forbidden. For Vienna style sausage, the amount of water added at the time of

chopping is about 20 to 30 pounds per 100 pounds of meat. (See Chapter X for drained net weights.)

(b) Preparation. The veterinarian should require that all equipment be sanitary, adequate, efficient and in good working condition, to facilitate the sanitary production of Army sausages. All silent cutter knives should be well sharpened to prevent tearing and heating of meats with their over heating and the production of a coarse, uneven textured sausage.

Fresh Pork Sausage. Pork trimmings should be inspected on the pork trimming floor and all bruises, seedy or other undesirable trimmings rejected. Barrels, trucks or other containers containing accepted trimmings should be tagged "U.S.A." by the veterinarian. The veterinarian should be present when the meat is ground. The meat may be run through an enterprise grinder with $\frac{1}{4}$ to $\frac{3}{8}$ inch plate and then mixed with salt, sage or other spices; or the meat placed into a silent cutter, spices added and quickly cut. For canning purposes, the meat should not be too fine. Trucks containing sausage meat should be tagged "U.S.A." The meat is then taken to the canning room. (See Chapter X.)

Smoked Sausage. For smoked sausages as Bologna, Frankfurters and Vienna style sausages, the following general procedures are given: The veterinarian should be present and inspect all cuts of beef used before they are trimmed, rejecting all bruised and sloppy pieces also skirts, head and offal meat and cuts showing an excess of connective tissue. All accepted beef should be trimmed, removing all tendons and excessive connective tissues, then placed into barrels or trucks and labeled, "U.S.A." Pork trimmings should be inspected on the pork cutting floor. The veterinarian should be present when the meat is ground and see that only U.S.A. inspected meat is used. All meat should be cured properly as discussed under "2. b.," above. Undercured meats when smoked, impart a dull gray color to sausages, the keeping qualities of which are also impaired.

Chopping. The beef may be ground in an enterprise grinder then placed into a silent cutter with ice and ice water added. After two and a half to three minutes chopping, the pork trimmings, more ice, water and spices may be added, and an additional two and a half to three minutes chopping given or until the desired fineness is attained. Overheating of the meat may cause it to sour. The stuffing, smoking, cooking and other processes should be supervised carefully.

Smoking. In the smoking of sausages, they should be so spaced that links do not touch each other, otherwise they will not attain sufficient dryness or color. Such sausages should be rejected. Sausages should be thoroughly smoked, the temperatures and time usually being left to the contractor. Smoked sausages should be dry and have a bright uniform color. A bright cherry red is desirable.

Cooking and other Processes. After smoking, the sausages should be properly cooked, cooled, inspected and weighed before packing. Usually the sausages should be of the best quality, properly seasoned, palatable and free from broken or short pieces or broken casings. Weights per sausage and packing should comply with specifications which should be consulted. (For canning of sausages see Chapter X.)

Packing. All wrapping and packing should be done in a sanitary manner and should be adequate to protect the sausages from dust or other contaminations. Twenty-five and 50 pound boxes lined with oiled, paraffined or other paper of good quality and strength to completely cover the contents; commercial quarter-barrels well filled and contents covered with brine; cans or other containers, may be specified. All containers and their markings should comply with requirements. Labeling and inspection legends should be affixed to the product, wrappings or containers in compliance with all sanitary and purchase requirements. Sausages should be handled, transported and stored under strict sanitary conditions.

Veal Loaf. All meats for veal loaf should be properly cooked to obtain a thorough shrinkage, otherwise the finished product will contain too much moisture. The meats are then cut in a silent cutter with the salt, spices and cracker crumbs added. After cutting, the product is ready for stuffing into the cans. (See Chapter X.)

One lot of veal loaf was prepared according to the following formula: 30 pounds of fresh pork, 2 pounds of salt, 5 ounces of pepper, 2 ounces of sage and 3 pounds of cracker meal. The cracker meal makes the product more friable.

(c) Inspection of Finished Sausage. The finished sausage should be typical of the class to which it belongs, and uniform in its various characteristics as to weight, fullness, dry condition, color of casings, odor, flavor, character of the meat used, fineness of texture, and color of the contents. After weighing and an external examination of selected samples, they should be broken apart. The quality of the casings should be noticed. When coloring matter has been used to dye the casings an examination should be made to determine if the contents

have been colored. The sausage should not crumble easily. The odor should be typical, pleasant and free from any suggestion of decomposition, sourness or rancidity. The sausages should be cut through with a sharp knife. This gives an even surface which facilitates a proper examination of the kind and character of ingredients used, their texture and color, all of which should be typical and uniform. A dull knife would make a ragged, uneven surface which is undesirable for a proper examination.

c. Inspection on Receipt. This is conducted whenever or wherever sausages are accepted, along the same general lines as outlined under Chapter VIII for fresh meats. The sanitary inspection on receipt should be adequate. This inspection may include such reëxaminations for quality, quantity wrappings, containers and markings as required by purchasing officers at time of delivery before final acceptance.

d. Inspection during Storage. The inspection of sausages in storage is along the same general lines, where applicable, as outlined for fresh meats Chapter VIII. (Also see "3. Packing, Storage and Shipment," above).

e. Inspection at Issue. A very careful sanitary examination should be given all sausages at issue. (See inspection at issue of fresh meats, Chapter VIII.)

f. Action. (See "Action," Chapter VIII.) Sausages or other miscellaneous meat products should be rejected when fly-blown, maggot-infested, rat- or mouse-eaten, or otherwise contaminated, when the meat is artificially colored, off color or discolored, mouldy, containing adulterations, an excess of cereal or moisture, or unauthorized preservatives, when improperly prepared or labeled, when tainted, soft, friable, slimy, smeary, sour, stinking or otherwise decomposed, deteriorated, unsound or unwholesome. For proof of deterioration or putrefactive process, the color, consistency, odor, taste and resistance should be taken into consideration; these, however, vary greatly and their detection must depend to a large extent upon the subjective perception by the veterinarian.

CHAPTER XIII

Products Inspection (continued)

G. MISCELLANEOUS MEAT PRODUCTS

1. General. Miscellaneous meat products not otherwise covered in preceding sections include edible products as gelatin, mincemeat, meat extract and rabbits; and inedible products as neatsfoot oil, glue, greases, tankage and fertilizer.

2. Edible Products. a. Gelatin. (1) Commercial Production. Selected, sound, edible glue stock as of skins and bones of a known sanitary source, and handled and stored properly, may be cooked under strict sanitary conditions at a low temperature to produce a sound and wholesome high testing glue or gelatin free from objectionable chemical substances and fit for food purposes. (See "Glue" under "3. Inedible Products.") Gelatin may be used for culinary or confectionery purposes, in ice cream and to enhance the digestibility of casein and milk fat in milk by inhibiting curdling of the casein.

(2) Army Requirements. Gelatin intended for troops should meet all sanitary requirements of the Surgeon General and procurement requirements concerned at time of manufacture, purchase, receipt, while in storage, during shipment and at issue.

The sanitary source, quality, packages, labeling and packing should comply with requirements.

Following is quoted the quality requirements of purchase specifications under date of 1919, however in each instance of purchase, Army veterinarians should be guided by the full current specifications at time of inspection:

GELATIN, PLAIN

Odorless in hot solution and tasteless, clear and light colored, of high jelly strength, ground from 30 to 50 mesh. To conform to the standards of purity adopted by the United States Department of Agriculture as to freedom from arsenic, copper, zinc, lead, and other harmful impurities. (Not more than 1.4 parts arsenic, as As_2O_3; 3 parts copper, or 100 parts zinc, per million parts gelatin are permissible.)

GELATIN, DESSERT POWDER

To contain about 86 per cent standard granulated sugar (sucrose), and from 10 to 16 per cent (depending on strength) gelatin.

Gelatin used should be odorless, or upon heating to have only the normal odor of gelatin; to be tasteless, clear, and light colored, of high jelly strength, ground from 30 to 50 mesh, and should conform to the requirements of the food and drugs act in freedom from arsenic, copper, zinc, and other harmful impurities. The finished powder to contain from 2 to 4 per cent of citric acid, calculated as crystallized citric acid plus one molecule of water of crystallization, with or without certified colors, or pure vegetable colors; flavor to be distinct and true to name. The ingredients to be mixed intimately, and the gelatin to be of such strength that one-fourth ounce will yield 1 pound of firm jelly at 60°F. The several ingredients to conform to the standards of purity adopted by the United States Department of Agriculture.

b. *Mincemeat.* (1) Commercial Production. Standard mincemeat of the Association of Official Agricultural Chemists, "is a mixture of not less than 10 per cent of cooked comminuted meat, with chopped suet, apples and other fruit, salt and spices, and with sugar, syrup, or molasses, and with or without vinegar, fresh, concentrated, or fermented fruit juices, or spirituous liquors." Mincemeat may be wet, dry or compressed.

Usually, the meat used will vary from 0 to 20 per cent and consist of finely chopped, cooked corned beef. Chilled beef suet may be ground through an enterprise grinder using crushed ice to prevent heating, and held in a vat of ice water until used.

All fruits, fresh or dehydrated, should be free from worms, deteriorations or other defects, and washed. Fresh apples, ripe or green, are washed, pared, cored and chopped. Evaporated apples, in the form of whole rings, or of a lower grade known as "chops" containing a higher amount of core and peel, or sundried apples, may be chopped, or ground in an enterprise grinder. Raisins may be seeded or seedless. Currants should be free from debris. Other fruits include citron, orange peel and lemon peel. Fruit juices include sweet cider. Cider or grain vinegar may be used. Refiners syrup is preferred to molasses. Glucose has been substituted for sugar. Brown or granulated sugar and salt may be employed. Water may be added to "wet" mincemeat to give proper consistency. Benzoate of soda has been used as a preservative. Spices include allspice, cinnamon, cloves, ginger, nutmeg and others.

Dried apples and other desiccated materials, with flour as a binder and without the addition of water or other fluid, may be dried and

without sterilization packed into tierces, barrels, kegs, tubs or other containers made of hardwood or other appropriate wood and paraffined on the inside. Dried mince meat may be compressed into 1 pound net cakes or bricks, wrapped in wax paper, enclosed in cartons and packed in cases. Under proper storage conditions dried mincemeat will keep over a long period of time.

Wet mincemeat may be packed into glass, earthenware, wooden or other tight packages and may be sterilized with heat.

(2) Army Requirements. The food products entering into mincemeat intended for troops should meet all sanitary requirements of the Surgeon General as to source, production, handling, storage and soundness at time of manufacture into the mincemeat, also those of the procurement authorities.

One specification dated 1919 in part required mincemeat to be of standard quality, from sound ingredients conforming with the National standards of purity and of desirable flavor. A list stating the names and proportionate amounts of ingredients and samples of the finished product may be submitted with bids. Packing may be accomplished in specified cans; moisture proof, fibre or wooden pails, tightly sealed; or other containers as required. (See specifications.)

c. Beef Extract. (1) Commercial Production. Beef extract is made by concentrating waters in which beef muscle and offal parts have been soaked or cooked, or from beef pickle. Soaking waters include those used for defrosting fresh beef, soaking fresh chilled meats prior to parboiling or of cured beef tongues prior to cooking. Cooking waters include those from parboiling fresh or canned beef prior to canning, or from offal parts as hearts and livers intended for sausage. Beef ham pickle may be used. Extract may be specially prepared from sound meats by grinding beef and beef offal parts, repeated soaking, using the soaking waters, and cooking the ground meat utilizing the cooking water. The extract may be concentrated to about 50 per cent to form a "fluid" beef extract or reduced to an 18 to 20 per cent moisture basis to form a solid extract. Sugar and sometimes caramel may be added to the product before packing and sometimes salt to that derived from fresh meats. Usually No. 1 beef extract is made from soaking or cooking waters of beef musculature, No. 2 from cooking waters of beef hearts and livers and No. 3 from such as beef ham pickle. Beef extract contains especially extractives and bases from meats.

Cooking waters are skimmed free from grease. The waters for extract may be heated to coagulate albumen, agitated, forced through a filter press and run into multiple effect vacuum pans at 180 to

200°F. The vacuum pans are heated by confined steam and are maintained under 15 to 27 inches of vacuum. Here ebulition occurs with the removal of moisture at a relatively low temperature. After a desired concentration is obtained, the product may be removed from the pan, beef blood added, heated to 190 to 200°F., allowed to stand half an hour, filtered through a filter press and again evaporated to about 40 per cent solids. It then may be drawn into a finishing kettle and boiled until nearly solid when it is known as "crude extract." The crude extract may be held thirty days, when it may be treated by adding sugar, caramel, salt and some water, mixed, boiled, settled, filtered, concentrated to about 80 to 85 per cent solids, agitated to impart a lighter color and a glossy, even appearance, and filled into metal drums, glass or earthenware jars or other containers. Tin packages are undesirable due to formation of black materials apparently iron or tin oleates and sulfides. If kept away from the air under good storage conditions, properly packed beef extract may keep 6 months.

(2) Army Requirements. These include the sanitary requirements of the Surgeon General as outlined in Army Regulations, for food products of animal origin, also the purchasing requirements of procurement authorities.

d. Bouillion Cubes. (1) Commercial Production. Bouillion cubes may contain beef extract, ground celery and tomato seeds, tomato pulp, spices, and other condimental substances. They contain a large amount of salt, sometimes from 50 to 64 per cent. Gelatin may be added to "stiffen" the product.

The ingredients may be mixed, warmed in a specially constructed oven, kneaded and packed into metal moulds or forms to produce ½ inch cubes. The cubes are removed, wrapped in metal foil and packed from 1 dozen to a gross in tinned containers or up to 100 in glass jars. Bouillion cubes may contain about 96 per cent of solids. They should not be stored at high temperatures, in a moist atmosphere or over too long a period of time.

(2) Army Requirements. These include the sanitary requirements of the Surgeon General as outlined in Army Regulations for food products of animal origin also the purchasing requirements of procurement authorities. The current specifications should be consulted by Army veterinarians in making inspection of bouillion cubes for purchase. One requrement dated 1920, stated in part as follows:

> To be commercially manufactured from concentrated meat extract or a combination of concentrated meat extract and concentrated plant extract of the best quality and pure, clean, common salt, sugar, spices, and beef fat. Meat

extract must conform to the standard adopted by the Association of Official Agricultural Chemists and the Association of State and National Food and Dairy Departments. Brand to be stated in each proposal and contract. To be purchased upon sample.

To be a preparation consisting of not more than 60 per cent pure, clean, salt and not less than 40 per cent concentrated meat extract, or not less than 40 per cent concentrated meat extract and concentrated plant extract combined, to which may be added pure, clean, sugar (sucrose) and beef fat in accordance with usual commercial practice, with a corresponding reduction in salt content; pressed into cube form approximately $\frac{12}{100}$ ounce each. Cubes containing less than 20 per cent concentrated meat extract will not be accepted.

Each cube to be separately wrapped in waxed or paraffin paper of approximately 19-pound basis, with an outer wrapping of tin foil approximately 5000 square inches to the pound, or in lieu thereof each cube may be separately wrapped in paper-lined foil conforming to the above requirements.

e. Rabbits. In the sanitary, veterinary examination of rabbits or hares, the Army veterinarian generally should be guided by the following:

Rabbits or hares should if practicable have the heart, lungs and liver hung by their natural attachments at time of examination.

Strongylides, Cysticercus pisiformis, or, Cuterebra cuniculi (grubs) when strictly localized, without evidence of acute inflammations or general impairment of the health of the animal; and, localized bruises or gunshot wounds, would require rejection only of parts involved.

Rejection should be made when any of the following conditions obtain: when not drawn (presence of gastro-intestinal or genito-urinary tracts), improperly bled, cleaned or dressed; fecal odor, decomposition or other deteriorations; emaciation; anemia, extensive bruises or gun-shot wounds; tularemia; coccidiosis (Eimeria stiedae); Multiceps serialis; or the fraudulent substitution of carcasses of cats.

3. Inedible Products. All inedible compartments or factories in connection with or on the premises of an establishment operating under Army veterinary meat inspection, or on a military reservation should comply with the sanitary requirements of the Surgeon General. Some of these requirements are discussed in Army Regulations. (Also see Chapter III, Handbook.)

a. Neatsfoot Oil. Usually neatsfoot stock is made from cattle feet but some grades are produced from the feet of calves, sheep and horses. The feet of cattle are the fore and hind legs inferior to the carpal and tarsal joints. The sinews are removed and sent to the glue house, the legs washed, hoofs cooked about thirty minutes in water at 165°F., hoofs removed, ends of shin bones sawed off and the knuckle bones sent

to the glue house. The shin and other foot bones are cooked in open vats, in water at 180 to 200°F., shin bones five to six hours, and foot bones ten to eleven hours. The vat is allowed to stand until the grease, called "neatsfoot stock" arises to the surface. This stock is skimmed or siphoned off, and passed through a cheese cloth strainer. The stock may be heated in a steam jacketed kettle at 210 to 250° for two to five hours for drying and sterilization, the steam turned off, settled six hours, and the neatsfoot oil filtered through cotton flannel, stored in an iron tank one day, and drawn off into barrels or tierces at 70 to 85°F., or, the stock may be refined by graining at 25 to 30°F. and pressed in a chill room at 36 to 40°F. to produce an oil which will flow readily at low temperatures. Twenty degree oil should flow readily at 20°F., and 30° oil at 30°F.

b. Glue. Glue is a complex organic substance variable in chemical constituents derived from animal matter as fish stock, hides, bones and sinews which are prepared, boiled with water and dried. The solvent action on collagen changes it by hydrolysis into glue. Hoofs and horns yield no glue.

(1) Preparation of Glue Stock. (a) Hide Stock. Green and cured hide trimmings, scrapings, parings or waste; cattle snouts, dew claws; hog snouts, ears and skins; and sheep trotters; may be limed, washed, alkalinity neutralized by a weak acid, bleached with alum or sulfurous acid or otherwise prepared for boiling.

(b) Bone Stock. Acidulated, dry or green bones with fleshings, fats and sinews and including cattle feet, tails, horn piths and knuckles; calf feet, tails and heads; sheep feet and heads; hog heads, feet, back and neck bones, and others, may be washed to remove dirt and blood; trimmed if desired; steamed to remove grease and large bones crushed before cooking. Acidulated bone may be neutralized with lime.

(c) Sinews. Sinews including such as tendons, ligaments, pizzles and cartilages as the larnyx, whether fresh, salted or dried, may be soaked briefly or washed in pure water which softens and removes the dirt and put through several successive baths of lime water, gradually increasing its strength until the sinews are swollen, soft and plump.

(2) Cooking. This may be accomplished by heating glue stock in water in an open tank at 158 to 190°F. for two to eight hours, or untreated bones may be subjected to 10 to 20 pounds of steam pressure in a closed tank. Prolonged cooking and high temperatures may cause degenerative changes in the glue.

(3) Bleaching. Provided the raw product has not been bleached, the glue liquor may be bleached by being subjected to sulfur smoke two to five hours.

(4) Evaporating. Glue liquors may be concentrated to about 20° Beaumé in vacuum evaporators.

(5) Whitening. If a white or opaque glue is desired, zinc oxide may be stirred into the evaporated glue liquor. The glue also may be treated with antiseptics if desired.

(6) Clarifying. If desired, clarification may be secured by heating the concentrated glue liquor adding a desirable substance to cause precipitation, then running the liquor through a filter press into pans.

(7) Cooling. The concentrated glue liquor may be run into pans, such as 8 inches deep, 6 inches wide and 12 inches in length; chilled in a cooler at 34° to 36°F. for fifteen hours to form a (glue) jelly; or a thin layer is run on a broad conveyor belt and run slowly through a cooling chamber where it becomes partly solid and elastic.

(8) Slicing. After chilling, the glue jelly is removed from the pans and cut into slices of any desired thickness by hand with a knife or wires, or by machines; or, removed from the conveyor belt and cut into sections about 4 feet long.

(9) Drying. The sheets are spread on wire nets, placed into a drying room or tunnel in a current of air at about 90 to 95°F. for twelve to twenty-four hours to dry. Powdered glue may be produced by running glue from the evaporator over a steam heated roll similar to a lard roll.

(10) Packing. Glue in the form of sheets, cakes, narrow strips, granulated or ground to a powder may be packed in packets, bags or barrels. Glue may be white, yellow, brown, opaque, amber, transparent or colorless.

(11) Tests. Glue may be tested for keeping qualities, odor, grease, foam, absorption, viscosity, melting point, rate of setting, jelly strength and adhesive qualities.

c. *Inedible Tallows and Greases.* In many departments of abattoirs and packing houses, especially on killing floors and in offal rooms variable amounts of numerous kinds of inedible animal tissues, organs, parts and refuse accumulate. These with carcasses of dead animals and carcasses and parts of slaughtered animals, rejected for disease or for other sanitary reasons, are removed to the inedible tank rooms for proper sterilization and rendering. Care should be taken that such materials are promptly conveyed to such tank rooms without passing

through edible compartments or rooms. Tank rooms should be separate from edible compartments, properly vestibuled, kept as sanitary as possible and equipped with appliances as condensors or other methods to suppress odors.

These materials may be rendered or sterilized in closed tanks under 35 to 40 pounds of steam pressure seven to nine hours similar to that for prime steam lard, or by a dry cooking method. The products obtained from inedible animal tissues include tallows or greases, tankage and tank water.

Usually, sanitary laws require the proper denaturing of inedible fats at time of rendering or later by means of coloring matters or other approved substances whereby the color, odor or flavor of the denaturant is sufficient to preclude the use of such fats for food.

Low grade offal may be included in a rendering tank to produce a color of the inedible fat sufficient for this purpose, or a mineral oil as power distillate, gas oil or equivalent having a specific gravity of not less than 0.819, flash point (cup) of not less than 75°C. and a boiling point of not less than 205°C. The oil added to a tank is based on the anticipated yield of fat and should be added in the proportion of one part of approved denaturing oil to 200 parts of the rendered fat. By check-weighing the rendered fat after drawing off, additional oil may be added if necessary to bring the amount up to ½ per cent.

(1) Closed Tank Rendering. Separation is made of tanks for hog, and cattle and sheep products; of "condemned" tanks for products rejected outright and "inedible" tanks for general packing house refuse and according to the grade of products rendered. Some sanitary regulations permit the skinning of certain dead animals in the inedible tank room and utilization of the skin or hide for manufacturing purposes under sanitary restrictions.

(a) Grading of Materials. Inedible, cattle and sheep fats and parts are graded into 3 groups, those suitable respectively for prime tallow, No. 2 tallow and brown grease. Inedible, swine fats and parts also are graded into 3 groups, from which may be produced white grease, yellow grease and brown grease respectively. The parts suitable for tallows and white grease may also yield a feeding tankage, while a low grade tankage for fertilizer is produced from the brown grease tanks.

Cattle and Sheep Parts. Prime Tallow. Prime tallow may be made from fresh, clean fats and parts of cattle and sheep as tongue, cheek, paunch, rennet, ruffle, hide cellar, cutting floor and bladder trimmings; oleo and cutting floor pickings; bone oil and catch basin skimmings;

certain oleo and bruised fats; ham bone grease; sinkers from chill vats; washed skulls, jaws and other bones; nodular and broken guts, fat and middle gut ends and gut stumps; hashed pecks and rennets; market and oleo scrap; pancreas, windpipes; ear tubes, tonsils, udders, lungs, gullets, slunks and rejected carcasses and parts.

No. 2 Tallow. All products not clean enough for prime tallow but too high grade for brown grease, including lean tissues containing fat, catch basin material, sausage room waste, entrails, pickled beef gullets and others may be rendered into No. 2 tallow.

Brown Grease. This is produced from products not clean enough for No. 2 tallow or too low in grade as meat tissue, spleens, dew claws, lungs, pecks, tripe scrapings and refuse.

Swine Fats. White Grease. White grease is produced from fresh, clean fats, trimmings, pickings, skimmings, scrap, bones, guts, tonsils, pizzles and other parts.

Yellow Grease. Products not good enough for white grease but of a higher grade than that for brown grease, including skimmings from settling tanks and rejected viscera may be used for yellow grease.

Brown Grease. Products not clean enough for yellow grease or of too low a grade may be used for brown grease.

(b) Rendering. All material if possible should be removed promptly to the tank room, hashed, thoroughly washed, tanked and rendered as quickly as possible in a manner similar to that for prime steam lard.

(c) Drawing off, Settling and Packing. The "draw off" is similar to that for prime steam lard, the melted tallow or grease being run through a small separator or settling device to settle out solid matter and to remove moisture, then into a tallow or grease vat. The tallow or grease may be held in storage tanks or tierces, and shipped in tank cars or tierces. They are used for soap manufacture, in tanneries, as lubricants or for other purposes while some are refined. Glycerine is a by-product of soap manufacture. Inedible lard oil and lard stearine may be made from white grease.

After drawing off the rendered fat, the tankage and tank water is dumped into a slush box. This is a receptable placed beneath the rendering tank. The further treatment of tankage and tank water is discussed under "d" and "e."

(d) Properties. Prime tallow is grayish-white and should contain not more than $\frac{1}{2}$ to 1 per cent of free fatty acids or $\frac{1}{2}$ per cent of moisture. No. 2 tallow is darker than prime tallow and should not contain more than 5 to 8 per cent of free fatty acids or 0.6 to 0.75 per cent or moisture.

"A" white grease should contain not more than 3 per cent free fatty acids and "B" white grease not more than 5 to 7 per cent. Yellow grease should contain not more than 10 to 15 per cent of free fatty acids, and brown grease not more than 25 per cent free fatty acids or more than 1 per cent moisture.

(2) Dry Cooking. By this method of rendering inedible materials it is claimed that low grade tallows, greases, and tankage are eliminated, with the production of the best grade of inedible tallow and white grease low in free fatty acid content and tankage of high protein content suitable for stock food, and the absence of odors during the rendering process and from the finished tankage.

(a) Drying and Melting. The melter is a steam jacketed, horizontal tank of about 3000 pounds capacity, equipped with an agitator and a tall exhaust stack somewhat more than one foot in diameter. All materials to be rendered should be put into the tank as soon as possible. Viscera is hashed and washed, bones may be crushed, and the meat divided into pieces of about 25 to 30 pounds. About 25 to 30 pounds of tallow or grease of the same grade to be rendered may be placed into the tank as a lubricant, then the tank may be charged through the galvanized exhaust stack, the pump of the condenser started to dry off the moisture after which steam is introduced into the jacket at 60 pounds pressure and the contents of the tank cooked under agitation. Beef material is cooked four to four and a half hours and swine parts two to three hours.

(b) Percolator. After cooking, the contents of a tank are dropped into a flat, shallow, jacketed pan called a percolator, spread out and kept at 240°F. for two hours for the tallow or grease to drain off. About 90 per cent of the fat will be recovered from the percolator. This fat is settled in a receptacle for half an hour then drawn into storage tanks.

(c) Expeller. Unless crushed, the large cattle bones are picked out of the percolator and dried over steam coils for bone products. The "cracklings" or residue from the percolator is pressed and the other 10 per cent of the fat recovered, the tankage then is ground and marketed. The expeller has a capacity of about 850 pounds per hour. It requires about five minutes to press a batch.

d. Tankage. The residue in inedible tanks from which the tallow or grease has been drawn off, is dropped into a slush box, recooked, the grease skimmed off, the tank water drained into a storage vat and the tankage washed to remove additional grease. The tankage then is pressed hot by hydraulic pressure into "cheeses" of about $\frac{1}{2}$ inch thick-

ness, and which contain about 5 to 7 per cent of fat and 45 per cent of moisture. The pressed tankage may be dried by means of direct or steam heat. A low grade tankage used for fertilizer has its nitrogen content expressed as "ammonia" while for high grade feeding tankage the nitrogen content is expressed as "protein." In the production of feeding tankage, hair, paunch manure and other products of low feeding value are excluded from the rendering tank.

Feeding tankage usually has blood, cracklings or concentrated tank water ("stick") added to increase the protein content to about 60 per cent. This tankage may be termed "digester" or "hog feed tankage." It should not contain copperas.

Some states have laws governing the percentage of protein in tankage for feeding purposes. In calculating the percentage of ammonia, the percentage of nitrogen is multiplied by 1.215. For the percentage of protein, the percentage of nitrogen is multiplied by 6.25. Thus 9 per cent of nitrogen is equivalent to 10.935 per cent ammonia, or 56.25 per cent protein. Fertilizer is quoted by units of ammonia per ton, one unit being 20 pounds. Tankage containing 9 units contains 180 pounds of ammonia per ton.

The method of producing feeding tankage by dry cooking is described under "c" above.

In the blow system of tankage handling, the gate valve of the pressure tank used for rendering is connected by a pipe, about 8 inches in diameter, with the tankage compartment several hundred feet away. After the melted fat has been drawn off from such a tank, the head is replaced, air or steam pressure introduced and when a pressure of 25 to 40 pounds is obtained, the gate valve is opened quickly and the entire tank contents are discharged through the pipe to the tankage room in a few seconds of time.

e. Tank Water. This includes waters from rendering tanks, also blood, tripe boiling and bone house cooking waters. Water from rendering tanks is cooked at 180 to 185°F. for eight to twenty-four hours in a tank water storage vat, grease recovered and the fine solids allowed to settle out. Tank water of 1° Beaumé or more, is evaporated in vacuum pans to 25 to 30° Beaumé when it is semisolid and termed "stick." Dry stick should not contain more than 2 to 3 per cent fat. The stick may be incorporated with tankage and dried. The old method of treatment was the addition of copperas and drying on steam heated rolls to a powder containing 4 to 5 per cent moisture.

CHAPTER XIV

Products Inspection (continued)

H. POULTRY

1. General. a. Poultry, Defined. Poultry refers to live or dressed domestic birds which have been bred and raised for edible purposes, for egg production or for showing, and includes chickens, ducks, guinea fowls, geese, ostriches, pea fowls, pheasants, pigeons, swans and turkeys.

b. Classification of Life Poultry. The different kinds of life poultry arbitrarily may be classified according to geographical sources, breed, variety, productiveness, sex, size, age, hardness of bone or other characteristic.

(1) Chickens. From an economic standpoint live chickens may be considered according to type, as meat, dual purpose, egg or ornamental, and according to various market requirements.

(a) Type. The meat type includes the Asiatics as cochins, weighing from 7 to 11 pounds, langshans $8\frac{1}{2}$ to 12 and brahmas $9\frac{1}{2}$ to 12 pounds when fully matured. Individuals of the meat type mature slowly, are of a lazy sluggish temperament and low egg production. They are characterized by good size, compact build, large and blocky body of good breadth and depth, full short legs, and a small amount of offal and bone waste. There is an abundance of soft flesh of superior quality present up to one year of age after which the meat becomes coarse and fibrous. Males are in the best flesh at seven to ten months. From breeds of the meat type broilers, roasters and capons are produced.

The dual or general purpose breeds of chickens include the plymouth rocks, orpingtons, wyandottes, Rhode Island reds, Cornish Indian games, dorkings and others. This type is intermediate between the meat producing and egg laying types and may combine the good qualities of both. The females of such breeds after passing their usefulness as layers may be used for meat. They are quiet in disposition and mature quickly, producing broilers at ten to fifteen weeks of age. They are of medium size, with a well proportioned, plump, blocky, compact body; rather short, plump legs and a good quality of flesh.

Average Weights of Dual Purpose Breeds

Breed	Cock	Hen	Cockeral (male under one year)	Pullet
	pounds	*pounds*	*pounds*	*pounds*
Plymouth Rock	9½	7½	8	6½
Orpington	10	8	8½	7
Rhode Island Red	8½	6½	7½	5
Wyandotte	8½	6½	7½	5½
Buckeye	9	6	8	5
Java	9½	7½	8	6½

Chickens of the egg type are small, active, long bodied, long legged, hard meated, quick maturing birds, high in egg production and weighing 3 to 6 or even 8 pounds when mature. Leghorns, Andalusians, Campines, Spanish, Hamburgs and other chickens are included in this type.

The ornamental type includes bantams, games, Polish and others.

(b) Market Classes. The market classes of live chickens embrace broilers, springs, fowls, stags, capons, poulards, slips and roosters.

A broiler is a young male or female chicken weighing up to 2 pounds. A spring or "fryer" is a young, soft boned, male or female chicken weighing over 2 pounds. A fowl is a female chicken too mature to be classed as a "Spring." This would include a pullet (under 1 year of age), showing hardness of the breast bone or keel, or a hen (over 1 year of age). A stag is a male chicken (cockerel) too mature to be classed as a "Spring" but not enough for the rooster class. Such will show hardness of bone and development of spurs and comb. A capon is a cockerel which has been castrated to facilitate fattening and for the production of soft meat. A poulard is an unsexed pullet. A slip is a capon which becomes hard meated or staggy due to a defective operation. A rooster or cock is a male chicken over one year of age.

(2) Ducks. Ducks may be classified according to type and market requirements. The meat type includes the Pekin, Swedish, Aylesbury, Cayuga, Rouen, Muscovy and Buff ducks. The egg type is represented by the Indian runner duck, and the ornamental type by the wood, call, black East India, mandarin and crested white ducks. Usually ducks are marketed young as "green roasting ducks." Such ducks, more particularly the Pekin breed, are specially fed to stimulate quick growth so that they can be marketed in eight to twelve weeks at weights ranging from 4 to 6 pounds.

(3) Geese. These include the economical and ornamental groups including Toulouse, Embden, Pomeranian, China, African, American wild goose and others. Geese are termed "young" up to one year of age after which time they are considered "old."

AVERAGE WEIGHTS OF GEESE

BREED	ADULTS		YOUNG	
	Gander	Goose	Gander	Goose
	pounds	*pounds*	*pounds*	*pounds*
Toulouse	20	18	18	15
Embdem	20	18	18	16
China	12	10	10	8
African	20	18	16	14
American wild	12	10	10	8

(4) Pigeons. The grades and crosses of the homer, Carneaux and runt pigeons may be used to produce large sized, soft fleshed, well developed squabs at three and a half to four and a half weeks of age.

(5) Turkeys. Usually turkeys are considered as one breed with 6 common varieties. Adult cocks are male turkeys two years or older in age, yearling cocks are males one year old and less than two years of age, hens are females one year or older, cockerels are males up to one year of age and pullets are females up to one year of age.

AVERAGE WEIGHTS OF TURKEYS

VARIETY	ADULT COCK	YEARLING COCK	HEN	COCKEREL	PULLET
	pounds	*pounds*	*pounds*	*pounds*	*pounds*
Bronze	36	33	20	25	15
Narragansett	30	25	18	20	12
White Holland	28	24	18	20	12
Buff, Slate and Black	27	22	18	18	12

From a market standpoint live turkeys may be classified as young or old. Young toms (males) and young hens (females) are under one year of age while old toms and hens are one year of age or older.

2. Commercial Production of Market Poultry. a. Fresh Poultry. (1) Transportation of Live Poultry. Market poultry may be transported by means of vehicles or cars in coops or crates, in specially constructed poultry cars capable of holding 3500 to 5000 chickens. or as sometimes

obtains for turkeys, driven overland. An attendant may accompany car load lots during long hauls, to water and feed poultry in transit.

Standard-sized coops have a floor 2 by 3 feet, being 12 inches high for chickens and 16 inches high for turkeys. It is preferable for the same kind of poultry of uniform size and weight to be shipped in a coop. The shipping loss, shrinkage in weight and condition of poultry upon arrival are influenced by the distance transported, also the sanitary conditions surrounding shipment as sanitation of shipping compartment, health of poultry shipped, crowding, extremes of temperature, ventilation, air circulation, feeding, watering and rough handling.

(2) Feeds and Fattening. Indifferent feeding methods usually produce unfinished poultry of unattractive appearance and inferior fat and flesh. Such birds may be meaty but not fat or both poor in flesh and fat with a thin body, a thin, wrinkled skin, prominent bones and hard, shrunken flesh.

Poultry of attractive appearance, with good quality of flesh and fat may be produced by special feeding or fattening methods wherein the exercise of the birds is limited or stopped and special rations containing an increased amount of fatty foods is fed over a period of ten days to four weeks.

(a) Farm or Pen Fattening. Poultry may be penned up to limit exercise and fed corn or mash feed for one to three weeks. Corn feeding may produce a yellow fat and skin.

(b) Crate or Milk Fattening. In crate fattening chickens, the birds are confined in stationary or portable coops or crates of various styles and construction and fed finely ground grain and milk mixed to the consistency of batter and which is placed into troughs just outside the coops. Turkeys and old cock chickens are not crate fattened. Hen chickens are not desirable for milk fattening.

Feeding rooms and coops should be well ventilated, cool, free from annoyances, cleaned daily, properly disinfected at least one time a week and kept sanitary. Feed should be sound, sanitary and properly prepared. Droppings, and dead and diseased birds should be disposed of in a sanitary manner and not allowed to accumulate.

Birds for fattening should be graded out according to soundness, condition, size and class. Unsound birds should be eliminated as being uneconomical or dangerous to the health of other birds. The heavy and dual purpose breeds are said to make good stock birds for crate fattening while the egg breeds due to a more nervous temperament are not so desirable.

Selected birds are confined in the fattening crates, fasted twenty-four hours during which time water only is given, then fed special rations 2 to 5 times daily for seven to fifteen days. The first feeds are light, after which full feeds are given, the birds being allowed only as much as they will clean up. The feeding materials which have been used include corn meal, corn flour, ground oats, oat flour, ground barley, wheat flour, beef scrap, tallow, alfalfa meal, grit, charcoal, milk and other materials. The milk may be sweet, sour, whole, skimmed or in the form of freshly churned, concentrated or dried buttermilk. Usually 60 to 65 per cent of fluid milk is used and other feeding ingredients varied according to preferance, weather conditions and other factors. One gallon of concentrated buttermilk represents the solids from 3 gallons of the churned product.

One establishment fasted chickens twenty-four hours allowing an abundance of water plus a small amount of salts. This was followed by an allowance of grit, then buttermilk for three days followed by a buttermilk and grain feed seven to nine days, and a twenty-four hour fast with water prior to slaughter.

By milk fattening in crates, white fat is deposited beneath the skin, the thigh and legs being the last to be covered. It is stated that 3 to $3\frac{1}{2}$ pounds of grain are required to produce 1 pound of gain, that broilers and fryers gain 30 to 35 per cent in nine days feeding and old hens about 15 per cent.

After fattening is complete, the birds are slaughtred immediately. Shipment of live, crate fattened birds is not desirable because bruising to the soft flesh and fracture of wing and leg bones may occur, and a large shrinkage which affects any gains which have been obtained through feeding.

(c) Cramming. Chickens and geese may be required forcibly to swallow food, so-called "cramming," which may be accomplished by hand, by means of a funnel or with a machine constructed for that purpose.

(3) Slaughter. Poultry which has been subjected to adverse, insanitary or other improper shipping conditions and those fatigued, excited, overheated or engorged with food materials are not in the best condition for slaughter and if killed may result in poor bleeding, a lower quality of flesh and in considerable waste. Poultry should be fasted twenty-four hours prior to slaughter. This will lessen the amount of ingesta in the enteron, promote a better appearance to each carcass especially in the crop region and increase the keeping properties by lessening the number

of bacteria in the intestines. Birds should have an abundant supply of water during the fast period to aid elimination.

The slaughter room should be sanitary with plenty of light and ventilation. The equipment should be adequate and proper facilities should be provided for the prompt and proper disposal of blood, feathers and ventings. Scalding, chilling and washing water and ice should be pure and clean. Only apparently healthy birds should be slaughtered.

Slaughtering may be conducted by dislocation of the head, "wringing the neck," beheading or sticking. When the head is dislocated, the suggillation forms in a pocket between the head and neck end, without external hemorrhage. Proper bleeding is not secured by this method. Guineas and pigeons are slaughtered in this manner. In wringing the neck or cutting off the head, the neck tissues including the blood vessels are injured or bruised, which, with the clotting of the blood, inhibit bleeding. Certain kinds of trade demand the head to be retained as an index to the condition of the carcass, breed and sex. When beheading occurs, proper restraint should be provided to prevent struggling. Bruises, resulting from birds in their death struggles hitting sharp objects, reduce their quality. A bird may be suspended by the feet, stunned with a block of wood, have a weighted blood cup attached by means of a hook into the upper mandible and the blood vessels of the throat severed. For "scald picking" any of the above methods of slaughter and bleeding may be used.

For dry picking it is necessary to destroy quickly some of the brain substance to enable the easy removal of feathers without the skin being torn. This is accomplished by "outside" or "inside" sticking with a short, strong, sharp pointed knife. The bird may be held by the operator or suspended from an overhead support by a hooked wire or cord looped around the feet, with the head hanging down. Outside sticking consists of inserting the knife under the eye, plunging it into the brain and twisting the knife around to destroy some of the brain tissue, then severing the blood vessels of the throat just posterior to the head. In inside sticking the knife is inserted into the mouth, midway in the superior groove and plunged into the brain accompanied by brain tissue destruction, then the anastomosing blood vessels on the right side of the roof of the mouth are severed. In either instance a weighted blood cup as described above is used to catch the blood and to aid in the stability of the bird during the defeathering process.

It is important that proper, thorough bleeding be secured. It has been estimated that almost one-third of the poultry marketed in some

large cities is bled improperly thereby reducing their quality and keeping properties. The flesh of such birds quickly loses its firmness, develops stale or other abnormal odors, while decomposition is more rapid. The engorged small veins of the neck, the small hemorrhagic spots where feathers have been removed especially on the wings and thighs, also a discolored, bloody, red, bluish-red purple or green-colored neck region, may obtain to poor bleeding.

(4) Dressing. Pigeons, guinea fowls and game birds are marketed without the feathers being removed. Other birds are scalded and the feathers removed, or dry picked.

(a) Scald Picking. Properly bled poultry may be scalded in hot water or steamed to relax the external tissues and thus render the removal of feathers easy. This method is employed for ducks, old cocks, fowls and others of a low grade, when desired for quick consumption or when demanded by the trade. It is said that yellow skinned birds present a better appearance when "scald picked."

Chickens. It is important that chickens are bled thoroughly before scalding, otherwise the surface blood coagulates and greatly lowers the appearance of the birds. When desired, the legs of chickens to be scalded, first may be dry picked. The temperature of the water should be 150°F. or above, sufficient to scald the carcasses but not so hot as to cook the skin with its subsequent tearing in depluming. A chicken may be held by the head and feet and the body immersed several times in the scalding water. Would the head be scalded, the eyes shrink and the head becomes the same color as the comb. Prolonged scalding may cook the skin. After scalding the feathers may be allowed to cool up to ten minutes the better to permit of plucking. The wing and tail feathers are pulled out and the remaining feathers rubbed off. Usually the feathers resulting from scald picking have no commercial value.

Food in crops of chickens which have been slaughtered without a fast period, may be eliminated by massage toward the head or through a small incision on the side of the breast well up toward the neck.

After plucking, each bird may be "plumped." This consists of dipping each carcass for seven to ten seconds in water heated to about 185°F. to tightly contract the skin after which the bird is placed into cold water to chill.

After two hours in the cold water the carcasses are placed into ice water, or if the weather is sufficiently cold they may be hung up to "dry cool." In chilling chickens in water, about 4 per cent of the meat proteins are dissolved out in one hour's soaking and a corresponding or

greater amount of water absorbed. The skin becoming soaked permits the ready penetration of bacteria.

From the chilling vat the carcasses may be placed on a shaping bench in a cool room. This permits drainage of surface water and the bodies to assume more of a plump or compact form. Should the birds be hung up, the muscles of the breast are stretched, the body appears thin, and such poultry is difficult to pack.

Ducks. As scalding water slowly penetrates the feathers of ducks they may be specially treated by rubbing powdered rosin into the feathers, followed by the regular scalding method; by scalding, then wrapping in hot burlap sacks to steam; by placing the carcasses in a steamer over boiling water; or by the use of dry steam, after which the feathers may be removed.

(b) Dry Picking. Turkeys, geese, squabs, and the better grades of chickens, especially broilers, fryers, roasters and capons, for certain markets or for storage over a period of time, may be dry picked. Dry picked poultry remains in a better state of preservation and has a better appearance than pertains to scalded carcasses.

Dry picking is accomplished immediately following sticking, as soon as the tissues are relaxed. The birds are "roughed," having the breast, neck, shoulder, back, thigh, wing and tail feathers removed by the operator grasping and giving them a quick, twisting and sweeping motion. Next the "pinners" remove the pin feathers with knives. The feathers on the last joint of the wings of turkeys and geese may not be removed. On capons, the feathers are allowed to remain on the head, two-thirds of the neck, two joints of each wing, on the tail and on the legs, two-thirds of the way to the hips.

White feathers are more valuable than colored ones and are put into separate bins. The body feathers also are kept separate from the wing and tail feathers.

Poultry should not be singed otherwise the fat tissues may be dissolved. The contents of crops may be pressed out, and vents massaged to exclude fecal matter. The feet and heads are washed and scrubbed with a bristle brush to remove blood and filth after which the heads are wrapped with paper to prevent soiling of the carcasses during chilling and packing. The feather, blood and vent shrink is about 9 per cent.

(5) Chilling. After picking, the birds should be chilled as quickly and completely as possible. They are hung on specially constructed portable racks, suspended by the feet with heads down, in such a manner that no two birds touch. This provides for air circulation and quick

cooling. They are allowed to hang at ordinary room temperatures one to two hours for the removal of the animal heat, after which the racks are run into a chill room at 33 to 36°F. for twenty-four to forty-eight hours. The chilling shrink is about 2 per cent and the storage shrink 2 per cent. The shrinkage from the live to the chilled weight is about 13 to 14 per cent.

(6) Drawing. Undrawn poultry decomposes less rapidly than drawn poultry and is more desirable for storage purposes. Whenever a carcass is opened for air borne infection, in addition to that from the viscera, decomposition is more rapid. Certain markets however require poultry to be drawn. A "full drawn" bird has the head and shanks cut off, crop removed and the viscera removed entire through a transverse abdominal incision. The trimmed and cleaned giblets and excess body fat then are returned to the abdominal cavity. A bird may have an incision made superior to or completely around the vent and the intestines removed, traction being exerted to break their attachment to the gizzard. In wire drawn poultry a finger is inserted into the vent, a loop of intestine is pulled out, the vent attachment severed and the intestines removed to the gizzard where the attachment is broken. In the latter two methods the head and feet remain attached to the carcass and the abdomen is collapsed.

(7) Grading. Dressed poultry is graded according to kind, method of dressing, class, use to which put, condition of flesh, quality, size and weight. Ordinarily the grades consist of No. 1, No. 2 and culls. The better grades are characterized by a good appearance; clean head and feet; a fine, soft textured skin showing underneath evidence of "milk" fat; thighs thick and short, with legs set widely apart; a long breast which is broad, deep and full rounded; a generally well developed, plump, compact, thick-fleshed condition with firm pliable musculature and a proper amount of fat. Some trades desire chickens with light colored or yellow skin, yellow shanks and white feathers. Defects include deformities, bruises, improper bleeding, diseases, broken wings or legs, wounds, contaminations, abrasions, torn skin, crop incisions, black pin feathers; carcasses not picked clean especially on neck, hocks and under wings; excessive pin feathers; food in the crop which becomes dark green upon storage; a full rectum; flabby loose skin; thin flesh; too much fat; prominent bones and general coarseness.

(a) Chickens. Sex may be determined by the development of certain characteristics as body conformation, spurs, and development and size of the wattles, comb and head. Fowls have a larger abdomen than

cocks. Cocks have coarser shanks and thighs and heavy spurs while the legs of fowls are more slender and have rudimentary spurs. Males have larger heads, combs and wattles than females.

Age is indicated by the size of a bird, the development of certain parts and the hardness of the posterior end of the breast bone. Mature chickens are more compact and hard, with well developed heads, wattles and combs; dull colored, rough and scaly shanks; coarse, stubby claws and a hard, unyielding cartilage on the posterior end of the sternum. Young chickens may have an elongated conformation; soft flesh; undeveloped head characteristics; bright, smooth shanks; rudimentary or small spurs; slender, pointed claws; and the posterior end of the sternum pliable and soft.

Scalded chickens may show openings where large feathers have been removed and a hard skin saturated with moisture and frequently torn thus allowing bacterial penetration. In dry picked chickens the feather follicles are closed, and the skin is pliable, soft and mellow. Occasionally a torn breast may be found.

Broilers. Birds of the dual purpose type from eight to fifteen weeks of age, with white plumage, yellow skin and legs, small shanks and feet, short legs, full thighs and breast, compact form, of uniform size and which have been force fed to produce quick growth and tender flesh, are desirable for broilers. Defects consisting of coarseness due to breed, age, slow growth or improper feeding, include large combs, wattles, bones and feet. Other defects included thinness, feathered shanks, dark pin feathers, and scald picking.

Fryers. Usually these are sold as large broilers or held for "roasters,"

Roasters. Young matured birds of the dual purpose or meat types, quickly developed, of good size for roasting, full, plump and meaty especially in the breasts and thighs with high quality flesh, are desirable for roasters. After a pullet commences to lay or a cockerel's spurs begin to harden, the flesh becomes hard. A roaster should have a pliable, soft keel, which if unyielding and hard would classify the bird as a "fowl." The egg type is not so desirable for roasters.

Capons. Capons are characterized by the style of dressing, and by female characteristics as undeveloped spurs, comb, wattles and a small head. Capons at eight to twelve months of age should weigh 5 to 12 pounds or over. Heavy capons are 8 pounds or over, medium capons are from $6\frac{1}{2}$ to 8 pounds and light capons 5 to $6\frac{1}{2}$ pounds.

Fowls and Cocks. Usually fowls are quite fat and are frequently used for fricassee. A drawn fowl with a large mass of fat protruding through

the abdominal opening is undesirable. Cocks are the least desirable as they are coarse and of an inferior quality.

(b) Ducks. If the trachea can be compressed readily between the thumb and fore finger the duck is young, if cord like or solid the duck is old. One author states, "The beak, in its relation to the width of the head, is considerably longer in young ducks, than in old ones."

(c) Turkeys. It has been stated that old turkeys have long, coarse claws, callused soles, rough scales on the feet and rose-red, or gray feet. Young turkeys have black feet up to one year. Old toms have large, fleshy wattles and dew bill or nose piece and a long, coarse beard, while on young toms the beard is just appearing or is absent. On turkey hens the beard may be absent or rudimentary, the head and nose piece small, legs and wings smaller than for toms and the body plump and small.

(d) Geese. The male may be determined by extrusion of the male organ upon pressure being applied to the vent.

Grades of Dressed Poultry

(National Poultry, Butter and Egg Association, 1921)

QUALITY

Poultry shall be graded into grades, No. 1 and No. 2.

No. 1 Chickens and Broilers shall be good, meaty birds, free from No. 2's and stags; well dressed; heads wrapped; feet clean.

No. 2 Chickens and Broilers shall be birds not good enough for No. 1's, such as hump-backed, defective dressing, torn, and thin in flesh; but contain no culls.

No. 1 Fowl shall be good, meaty birds; well dressed; head wrapped; feet clean.

No. 2 Fowl may be pin-feathery, poorly dressed, skin broken or defective dressing, and torn, but free from culls.

No. 1 Ducks to be all birds of good flesh; well dressed; feet clean.

No. 2 Ducks, birds not good enough for No. 1's, such as deformed, defective dressing, and torn, but free from culls.

Geese—Same as Ducks.

No. 1 Turkeys, to be all good flesh; not bruised; feet clean.

No. 2 Turkeys, birds not good enough for No. 1's such as crooked breasts and defective dressing; or birds whose wings or legs have been broken or bruised while being dressed.

All birds to be free from feed; no birds in the No. 2's that show evidence of having been diseased when killed.

WEIGHTS

Broilers, Squab, birds weighing $1\frac{1}{4}$ pounds and less; no boxes to weigh more than 15 pounds. Small birds, weighing over $1\frac{1}{4}$ pounds to $1\frac{3}{4}$ pounds; no boxes to weigh more than 20 pounds. Medium birds, weighing over $1\frac{3}{4}$ pounds to $2\frac{1}{8}$ pounds; no boxes to weigh more than $20\frac{1}{2}$ pounds. Large birds, weighing over $2\frac{1}{8}$ pounds to $2\frac{5}{8}$ pounds; no boxes to weigh more than 30 pounds.

No. 2 Broilers, small, birds weighing $1\frac{3}{4}$ pounds and less. No. 2 Broilers, large birds weighing $1\frac{3}{4}$ pounds to $2\frac{5}{8}$ pounds. Broilers to be wrapped; packed breasts up; one layer boxes unless otherwise specified; boxes lined with parchment paper; heads wrapped; feet clean.

Chickens, Small Fryers weighing over $2\frac{5}{8}$ pounds to $3\frac{1}{8}$ pounds; no box weighing over 36 pounds. Large Fryers, weighing over $3\frac{1}{8}$ pounds to $3\frac{5}{8}$ pounds; no box weighing over 42 pounds. Small Roasters, weighing over $3\frac{5}{8}$ pounds to $3\frac{7}{8}$ pounds; no box weighing over 47 pounds. Medium Roasters weighing over $3\frac{7}{8}$ pounds to 5 pounds; no box weighing over 55 pounds. Large Roasters weighing over 5 pounds to 6 pounds. Extra Large Roasters, 6 pounds and over.

No. 2 Chickens, small, weighing over $2\frac{5}{8}$ pounds to $3\frac{5}{8}$ pounds. No. 2 Chickens. large, weighing over $3\frac{5}{8}$ pounds.

Stags, small, weighing $3\frac{7}{8}$ pounds and under. Stags, large, weighing over $3\frac{7}{8}$ pounds.

No. 1 Fowl, small, birds, weighing 3 pounds and under. No. 1 Fowl, medium, birds weighing 3 pounds to 4 pounds. No. 1 Fowl, large birds weighing 4 pounds to 5 pounds. No. 1 Fowl, extra large, birds weighing 5 pounds and up.

No. 2 Fowl, small, birds weighing 4 pounds and less. No. 2 Fowl, large, birds weighing 4 pounds and over.

No. 1 Ducks, medium, birds weighing $3\frac{1}{2}$ pounds to $4\frac{1}{2}$ pounds. No. 1 Ducks, large birds weighing $4\frac{1}{2}$ pounds and up.

No. 2 Ducks, all sizes.

No. 1 Turkeys, Young Toms, any size. No. 1 Turkeys, Hens, all sizes, but natural proportions of old and young mixed.

No. 1 Geese, small birds weighing 8 pounds and under.

No. 1 Geese, medium, birds weighing 8 to 11 pounds.

No. 1 Geese, large, birds weighing 11 pounds and up.

PACKING

All poultry packed 12 birds to the box; all boxes to be lined with parchment paper unless otherwise specified.

PACKAGES

Packages shall be new, uniform, and of sufficient strength to carry the product in good condition.

MARKING

It shall not be necessary to mark anything except the net weight of the poultry on the packages; it will be understood that every package contains 12 birds, unless marked otherwise.

TESTING WEIGHTS

All weights shall be tested by taking the contents of five packages, weighing them at one time, and adjustment shall be made between the net weight of the five packages weighed at one time, unless otherwise agreed upon, and the marked weights. Seller must specify the state in which poultry is packed.

All No. 1 poultry shall be dry and sweet.

No. 2 poultry may be slightly damp, but must be in a good, merchantable condition.

(8) Packing. There are many methods of packing chilled poultry. Because of the amount of moisture absorbed by the skin and flesh and the extent of bacterial penetration, scalded poultry does not keep well and usually is disposed of in a chilled condition. Such poultry may be packed in new, clean barrels constructed as to afford drainage at the bottom. Barrels may be lined with waxed or paraffin paper, a layer of crushed ice placed in the bottom, the poultry packed in the barrel with feet toward the center and backs up, another layer of cracked ice placed in the middle and a large layer or pieces of ice on top. Barrels may be covered with paper, cheese cloth and burlap. Poultry packed in this manner may be shipped with safety for two days by express, or five days in a refrigerator car which has been properly precooled and maintained at 34°F. For local consumption, scalded poultry may be stored at 22°F.

Dry picked, corn or milk fed poultry which has been properly chilled, may be dry packed in clean boxes or barrels with one grade per package. The boxes used vary in size according to the grade of poultry and hold 1 or 2 dozen birds. Containers should be tightly constructed to prevent drying out of the product, and may be paper lined to exclude air and to prevent staining and abrasions from rubbing. For freezing, small boxes are preferable to large ones. No. 1 and No. 2 grades may be boxed for freezer storage or for shipment, while culls and sometimes broilers may be barreled and sold fresh. In packing into barrels, broilers may have the wings folded over the back and packed in concentric layers. Broilers may be packed into boxes in 1 or 2 layers, breasts up, with heads and legs hidden beneath the body, or "squatted." Roasters, capons, and others may be packed on the side, the breast or the back. Poultry should be packed solidly and tightly to prevent shifting during handling and to exclude the air.

Standard Methods of Packing Poultry
(Poultry Packers' Guide)

1. Standard Broiler. Wrap heads; line box with parchment paper. Pack 1 dozen birds to the box, 6 birds on each side with feet extended past the center of the box. The breasts should be up, heads and feet hidden. The head is packed under and to the side of the bird it belongs to, and the feet crossed with those of the opposite bird, and tucked under the opposite bird. Be careful not to draw out the legs too far so that the bird will lose its plump appearance.

2. Standard Export. Pack in single layer boxes. Line the boxes with parchment paper. Heads not wrapped. Pack 6 birds with breasts up; 6 birds with backs up; heads brought forward and turned sideways so that the eyes show. A box packed in this style has the same appearance on both top and bottom.

3. Standard Roaster Style. All heavy fowl and turkeys should be packed in this style. Some capons are also packed in this style. Boxes lined with parchment paper. Heads wrapped. Pack twelve birds to the box in two layers. Parchment paper between layers. Bottom layer heads and feet up. Top layers heads and feet down. Both layers packed on both sides and butts locked. To accomplish this 3 birds are packed with breasts one way and three breasts the opposite way.

4. Single Layer Roaster Style. Is used when marketing extra fine stock for a particular customer. Arrange as in upper layer of the Standard Roaster Style, but pack in a single layer.

5. Standard Duck Style. Is used for both ducks and geese. Pack in 2 layers, 12 to the box. Line boxes with parchment paper. Wrap heads. Parchment paper between layers. Lower layer breasts down, feet and heads up. Upper layer breasts up, heads and feet down. Both layers packed butt to butt.

6. Standard Capon Style. Use deep box. Twelve to the box in 2 layers. Line box. Wrap heads. Parchment paper between layers. Lower layer, breasts down, heads and feet up. Upper layer, breasts up and heads and feet down. Legs crossed with those of the opposite and feet buried.

(9) Freezing. Freezing of poultry is conducted at seasons of greatest production or at other times to insure a supply of a commodity during the short season or for shipping purposes. Scalded poultry is not desirable for freezer stock, as due to freezing, the moisture ladened cells of the skin rupture, forming "blisters" over the body thus lowering the appearance. Poultry to be frozen should be well bled, otherwise sound, fresh, properly chilled and packed in small containers. The internal temperature of a bird intended for freezing, as shown by a thermometer inserted in the vent should not exceed 35°F. Poultry should be frozen quickly to retain a bright, clear, fresh appearance or color. Where slow freezing occurs due to higher temperatures or too large a package, as barrels, poultry will lose this fresh appearance or "bloom" and may become "reddish." Boxes of poultry for freezing should be spaced on racks or dunnage or staggered as described under cold storage of fresh meats, Chapter VIII. At zero to 15° below zero freezing under these conditions may be accomplished in two to three days.

(10) Storage. Cooler storage of scalded poultry is discussed under "Packing." Frozen poultry should be stored at evenly maintained temperatures not to exceed 15°F. (See Chapter VIII, "Cold Storage of Fresh Meats.") Under these conditions of proper cold storage, properly prepared and sound poultry should keep nine months. Should poultry be stored two or more years, it becomes dry, lacks flavor, the tissues disintegrate and there may be an increase in bacterial growth. Cadaver spots of a whitish yellow to green color and hypostasis of the skin of the abdominal region may occur in long cold storage of geese. Usually

cold storage of food products of animal origin is controlled by Federal, state or municipal regulations.

(11) Shipment. Dressed poultry should be shipped in properly precooled and iced refrigerator cars as discussed in Chapter VIII. "Shipment of Fresh Meats." A temperature below 31°F. is desirable for long hauls. Properly protected, sanitary conveyances may be used for local delivery.

(12) Defrosting. Frozen poultry may be defrosted at cooler temperatures in eighteen to thirty-six hours. Thawing in cold water results in loss of flavor and enhances bacterial growth.

b. Canned Poultry. This includes canned chicken and turkey, deviled chicken, chicken soup and other poultry products principally derived from old, torn, scrawny or other lower grade chickens or turkeys and which are not too fat. The birds are slaughtered, dressed and drawn and the carcasses parboiled to facilitate boning. After parboiling and boning, the fat, white meat and dark meat are separated, later to be combined in definite proportions to produce a uniform canned product, or as desired. (See Chapter X.)

3. Veterinary Examinations. The steps involved in the veterinary examinations of poultry intended for troops include the sanitary source; the sanitary supervision of and methods employed throughout the various processes of receiving, fattening, slaughter, dressing, chilling, drawing, grading, weighing, packing, freezing, storage, shipment and defrosting, of fresh poultry; antemortem and postmortem examinations; canning and inspections at time of purchase, receipt and issue with such re-inspections as are required. It also includes the sanitary location, construction, equipment and methods of operation of establishments involved as defined by Army Regulations (See Chapter III, Handbook).

a. Fresh Poultry. The inspections of fresh poultry prior to purchase, on receipt, during storage and at issue generally are along the same lines as discussed under Chapter VIII "Fresh Meats." Wherever practicable veterinary antemortem and postmortem examinations are desirable, otherwise poultry should be undrawn and have the feet and head attached at the time of inspection. A superficial examination while generally the only inspection given, cannot be considered thorough inasmuch as the internal conditions are not ascertained by such procedure.

Frozen poultry is inspected with difficulty. In the reinspection of undrawn frozen poultry an abdominal trier inspection has been recommended.

The inspector should determine age and the presence of impacted crop, congested or degenerated liver, rupture of the oviduct, abdominal egg concrements, contaminations or other conditions; action being taken as each individual case would require from a sanitary standpoint.

Poultry should be rejected for any of the following conditions or diseases: sorehead (chicken-pox), contagious epithelioma or roup; chicken cholera or other septicemias; entero-hepatitis of turkeys; tuberculosis, pneumonomycosis, infectious leukemia, purulent peritonitis, coccidiosis, sarcomatosis (common in fowl), cachectic or anemic conditions from any cause, emaciation, "cadaver" spots, extensive fractures, bruises or discolorations, decompositions, maggots, generalization of connective tissue mites, severe arthritis, improper bleeding, extensive inflammation.

Current purchase specifications regarding fresh or frozen, drawn or undrawn, chickens, turkeys or other poultry should be consulted.

b. Canned Poultry. The inspections of canned poultry prior to purchase, on receipt, during storage and at issue generally are along the same lines as discussed under Chapter X, "Canned Meats." Current specifications regarding canned poultry should be consulted.

CHAPTER XV

PRODUCTS INSPECTION (CONTINUED)

I. EGGS

1. Fresh Eggs. As discussed in this section "eggs" refer to "hen" or chicken eggs, although eggs of ducks, guineas and other birds sometimes are utilized for edible purposes.

a. Structure. A normal egg as produced consists of a shell, a membrana testacea, a white substance and a yolk.

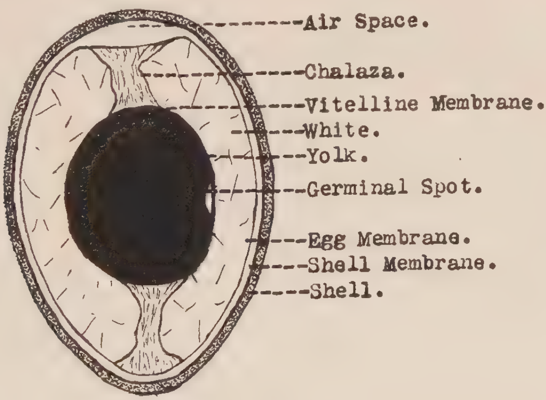


FIG. 53. STRUCTURE OF AN EGG
(Diagrammatic)

(1) Shell. The shell consists of several layers of calcareous material, principally calcium carbonate. The inner or mammillary layer consists of small conical masses, the middle or spongy layer shows a compact fibrous network while the outer layer is more delicate and is cuticle-like in structure. The shell is porous and depending on the breed of chickens, is white to dark brown in color.

(2) Membrana Testacea. Inside the shell is a double membrane, fibrous in structure and composed chiefly of keratin. The outer portion or shell membrane closely contacts the inside of the shell and is tougher and thicker than the inner or egg membrane which encloses the egg contents. When an egg is laid, it is warm, the egg contents completely

fill the shell and these two membranes contact each other throughout, but upon cooling, due to the contraction of the egg contents there is a separation of the egg membrane from the shell membrane at the large end of the egg thus producing an air space. The air space at first is about $\frac{5}{8}$ inch in diameter, but increases in size with age, due to evaporation of moisture from the egg contents.

(3) White. The white of an egg is a firm, gelatinous substance composed of a fine network of interlacing keratin fibres enclosing protein and water. It has three layers, a middle thick layer and outer and inner thin layers. At either pole there is a dense, opaque, twisted, cord-like coil of white substance called "chalazae." These extend from the yolk membrane to the egg membrane suspending the yolk in a centrally located position but allowing it to turn freely.

(4) Yolk. The yolk of an egg consists of a delicate yolk or vitelline membrane of keratin, enclosing the yolk substance and germinal disc. It floats in the white, suspended by the chalazae, with the germinal disc on top.

The yolk substance consists of white and yellow layers composed of fat, protein and water and is from a light yellow to a golden orange in color and sometimes olive green.

The germinal disc or spot is a small, light colored, circular area on the surface of the yolk and from which a chick may develop. It is present in both fertile and infertile eggs.

b. Production. In the hen only the left ovary develops and functions. The ovarian mass includes 3000 to 4500 ova in different states of development. These ova develop one by one into yolks each containing a blastoderm. Upon a yolk going through the oviduct the white is first formed around it in the albumin-secreting portion, in the isthmus the membrana testacea is formed, in the uterus the shell and the vagina the shell cuticle or "bloom," and in certain breeds the tint or pigment.

c. Characteristics. A fresh, normal egg is characterized by the "bloom" which disappears with handling or upon two to three days air exposure. The egg is full; the air space small; the white is clear, opalescent, thick and firm; and the yolk is uniform in color, spherical, firm and restricted in movement. The average weight of an egg is 2 ounces. The shell represents 10 to 11 per cent of the total weight of the egg, the membrana testacea 0.25 per cent, the white 57 per cent and the yolk 31 to 33 per cent. The general composition is water 64.25 to 65.5 per cent, protein 10.25 to 12 per cent, fat 9.3 to 10.6 per cent and ash 9 per cent.

d. Candling. Eggs are subject to rapid deterioration. At time of production they may be fertile, infertile, sterile or contain bacteria, moulds, debris, blood clots or vermes. Eggs may absorb odors and flavors, the shell is fragile and easily broken, and the porous shell may admit microorganisms and the escape of moisture vapors. Fertile eggs may germinate at temperatures as low as 68°F.

Dirty, broken, frozen, small or malformed eggs readily may be determined by the unaided eye, for others "candling" is resorted to or the breaking test given. The Federal Food and Drugs Act prohibits the interstate transportation of cases containing large percentages of defective eggs which are considered to be adulterated food. Certain states and cities also have regulations governing the selling of bad eggs. Candling consists of holding an egg between the eye and a strong light in such a manner that the condition of the contents of an egg may be determined. Usually candling is conducted in a dark room using a light enclosed in a candling hood having an aperature of suitable size to accommodate the examination of one or two eggs held in the hand. Tray candling also is used.

In candling, the egg is held in a slanting position with the large end against the opening of the candling apparatus. A few, moderate, rapid twists are given to the right and to the left sufficient to expose the entire surface of the egg, noting the size of the air cell and conditions of the shell, yolk and white. The egg then should be turned from end to end so that the entire egg again is visualized. One side of an egg may appear normal, but the other side may present defects when brought into view.

Eggs should be clean at time of candling. Cracked eggs are more accurately determined by candling. The air space in an egg increases with age and most bad eggs have enlarged air cells. "Movable" air cells generally pertain to a stale or spoiled condition. Watery whites usually are caused by bacterial invasion. Whites may be yellow, bloody, mouldy, green or otherwise discolored; or contain foreign bodies as blood spots, debris or parasites due to inclusion in the oviduct. The condition of the yolk is an important determining factor in judging soundness: "addling" or mixing of the yolk and white as mixed rots, incrusted yolk, yolk adhering to the shell, colored yolk, blood rings, embryos and heavily mottled yolks, may be found. Such eggs are unfit for food. Eggs with green whites, musty eggs and sour eggs as a rule cannot be detected by candling. Boiled eggs and eggs containing fully developed chicks show black before the candle.

e. Classification. Eggs are graded according to freshness, size, color, cleanliness and soundness of the shell. Various markets have differ-

ent adopted classes and grades. The National Poultry, Butter and Egg Association grades given under the date of April, 1921, are as follows:

Eggs shall be classed as Fresh Gathered, Storage Packed and Refrigerator.

They shall be graded as Extra Firsts, Firsts, Seconds, Dirties and Checks.

"Loss" as used in these rules shall comprise all rotten, broken (leaking), spots, broken yolked, frozen (split), hatched (blood veined) and sour eggs. Very small, very dirty, cracked (not leaking), badly heated, badly shrunken, salted and chilled eggs shall be counted one-third loss in all grades excepting Seconds, Dirties and Checks.

In the following rules 'loss' as referred to in excess of the allowance for rotten eggs shall be determined by counting three defective eggs, such as small eggs, dirty eggs, checked eggs or other eggs fit for human food and at the same time defective, as being and meaning one egg loss. And it is understood that every three such defective eggs shall be termed and considered one egg loss. "Leakers" and "smashed" eggs shall not be included in the foregoing computation, but in all instances every leaker or broken egg shall by itself be counted total loss.

Nor shall there be allowed an excess of an average of 12 visible checks per case in 5 per cent of all cases contained in a shipment of any grade provided for herein except checks.

"Extra Firsts" (between June 1 and December 1 only) shall be packed in new or standard 30-dozen cases, unless otherwise specified at time of sale; shall consist of clean, fresh, reasonably full, strong, sweet eggs, 60 per cent, and net average weight 44 pounds or over, no case of sample inspected to weigh less than 43 pounds.

The balance, other than the loss, may be defective in strength of fullness, but must be sweet. There may be a total average loss of two dozen per case; and of this average loss, the loss in bad eggs must not exceed nine eggs.

Fresh Gathered Firsts shall be packed in new or standard 30-dozen cases, unless otherwise specified at time of sale; shall consist, of clean, fresh, reasonably full, strong, sweet eggs as follows:

February 20 to May 15, 65 per cent, and average weight 42 pounds or over, net, no case of sample inspected to weigh less than 41 pounds.

May 16 to February 19, 50 per cent, and average weight 42 pounds or over, net, no case of sample inspected to weigh less than 41 pounds.

The balance, other than the loss, may be defective in strength or fullness, but must be sweet. The dead loss in bad eggs must not exceed one dozen per case, and the total average loss may not exceed two dozen per case, excepting between July 1 and August 15, when the dead loss in bad eggs may be one and one-quarter dozen and the total average loss may not exceed three dozen per case.

"Fresh Gathered Seconds" must be packed in new or standard 30-dozen cases, unless otherwise specified at time of sale, shall be reasonably clean and shall consist of fresh, reasonably full, strong, sweet eggs, as follows:

February 20 to May 15, 50 per cent, and average weight 40 pounds or over, net, no case of sample inspected to weigh less.

Balance of the year, 40 per cent, and average weight 40 pounds or over, net, no case of sample inspected to weigh less.

The balance other than the loss, may be defective in strength or fullness, but must be sweet. There may be a total average loss of 3 dozen per case, but of the total average loss, the loss in bad eggs must not exceed 1½ dozen per case.

Storage Packed shall be the term applied to eggs put up for storage. They must be packed in new 30-dozen whitewood cases, unless otherwise specified at time of sale. The fillers must be new and dry No. 1 or medium strawboard with flats of excelsior cushion over top and under bottom layers. Corrugated flats may be used on tops only. No. 1 quarter fillers may be used on tops only. The padding may be kiln-dried excelsior on top of each case; no pine excelsior to be used. Any car of storage packed eggs in which washed eggs are found will be deemed as not fit for storage and will be reported "no grade."

"Storage Packed Extra Firsts" shall contain from March 15 to May 31, 80 per cent and for balance of year 70 per cent of clean, reasonably full, fresh, sweet eggs and weigh 44 pounds average net per case, no case of sample inspected to weigh less than 43 pounds. The total average loss may be 1¼ dozen, but of this there must not be over one dozen checks per case, nor more than three bad or broken eggs between March 15 and May 31. The balance of the year the average loss may be 1¾ dozen, but not more than 6 bad or broken eggs.

"Storage Packed Firsts" shall grade as follows: From March 15 to May 31, 70 per cent clean, fresh, reasonably full, 43 pounds average net weight, no case of sample inspected to weigh less than 42 pounds.

Balance of the year, 55 per cent clean, fresh, reasonably full, 43 pounds average net weight, no case of sample inspected to weigh less than 42 pounds.

March 15 to May 31, the total average loss must not exceed 1½ dozen, and of this loss there must not be over twelve (12) checks per case, and the bad and leaky eggs must not exceed one-half dozen.

Balance of year the loss must not exceed two (2) dozen per case. Of this loss the leaky, bad or rotten must not exceed nine eggs per case.

"Storage Packed Seconds" shall grade as follows: From March 15 to May 31, 55 per cent fresh, reasonably full, 42 pounds net weight, no case of sample inspected to weigh less than 41 pounds.

Balance of the year, 40 per cent fresh, reasonably full 41 pounds net weight, no case of sample inspected to weigh less.

The total average loss must not exceed 3 dozen, of which there must not be over 1½ dozen checks per case, and not more than 1 dozen rots, spots or leakers.

REFRIGERATOR EGGS

In making offerings of refrigerator eggs they may be further designated by stating the month in which they were stored and the storage certificate shall be taken as prima facie evidence of the day and month when stored. The storage house may also be stated, and unless otherwise specified when sold as in storage, the storage charges for the season must be paid by the seller.

Refrigerator and Held Fresh Eggs shall be graded as follows:

All eggs offered as refrigerator shall be sweet and free from mildew or foreign taste or odor.

Extra Firsts must be sweet and reasonably full and in grading, packing and selection, shall have the appearance of having been storage packed Extra Firsts at the time of storage; must average 43 pounds or over net and no case of sample

inspected to weigh less than 42 pounds. The total loss must not be over one and one-half dozen, of which not more than 6 eggs may be rots, spots or leakers.

"Firsts" must be sweet and reasonably full and in grading, packng and selection shall have the appearance of having been storage packed Firsts at the time of storage. Must weigh 42 pounds average net, no case of sample inspected to weigh less than 41 pounds and the total loss must not exceed two dozen per case, of which not more than 9 eggs may be rots, spots or leakers, excepting after January 1, when the total loss must not exceed 2½ dozen per case, of which not more than 1½ dozen may be rots, spots or leakers.

"Seconds" must be sweet and reasonably full and average 40 pounds or over, net, no case of sample inspected shall weigh less. In grading, packing and selection shall have the appearance of having been storage packed at the time of storage. The total loss must not exceed 3½ dozen, of which not more than 1½ dozen may be rots, spots or leakers.

Dirties in storage may be offered as No. 1 Refrigerator Dirties and in grading, packing and selection shall have the appearance of having been storage packed at time of storage. No. 1 Dirties must average 41 pounds net, and no case of sample inspected to weigh less than 40 pounds and the total loss must not exceed three dozen per case, of which not over 1½ dozen shall be rots, spots or leakers, and not over 2 dozen cracks.

OTHER GRADES

"No. 1 Dirties" shall be packed in new or standard 30-dozen cases unless otherwise specified at time of sale. The quality and loss requirements, apart from cleanliness, shall be the same as specified for firsts in the class in which they are offered. The minimum net weight shall be 1 pound per case less than provided for firsts as specified in the class in which they are offered.

"No. 2 Dirties" shall be packed in new or standard 30-dozen cases, unless otherwise specified at time of sale. The quality and loss requirements, apart from cleanliness, shall be the same as specified for Seconds and the minimum weight may be 1 pound per case less than provided for Seconds as specified in the class in which they are offered.

When sold as Storage Packed, No. 1 Dirties, must be packed in the same way as other eggs packed for storage.

No 1 Checks shall comprise cracked and checked eggs and must be 95 per cent free from leakers. They must be of good useful quality in the season when offered and the loss must not exceed 2 dozen to the case from February 16 to May 15 or 3 dozen from May 16 to February 15, of which not over 1½ dozen shall be spots and rots.

QUANTITY

A car shall contain 375 to 400 cases, unless otherwise specified, and in cases of settlement 400 cases shall constitute the basis.

INSPECTION

(1) Certificates of inspection of eggs stored prior to June 1st shall be good for thirty (30) days up to and including October 31st; inspections made from November 1st to November 15, inclusive, shall be good to December 1st; inspections made

from November 16 to December 15, inclusive, shall be good for fifteen (15) days and for the balance they shall be good for ten (10) days; (2) Certificates of Inspection of eggs stored from June 1st on shall be good for ten (10) days—provided in all cases the eggs remain in the same room and have received proper care since they were inspected.

When offering fresh gathered eggs for sale, sellers must specify the state where eggs offered were produced and packed.

The following number of cases shall be necessary to constitute an inspection:

SAMPLES

Lots of 100 cases	5 half cases
Lots of 100–300 cases	8 half cases
Lots of 300 cases or over	10 half cases

In sales of car lots if the inspector, after opening the covers of 10 half cases, finds that 5 or more cases are badly damaged necessitating the overhauling or rehandling of the car, the inspector shall notify the person applying for the inspection of the condition, either by telephone or telegram.

Certificates of inspection for all classifications except Refrigerator Eggs shall be good for three days after date of issue, provided the eggs have been properly taken care of during the interval.

The Inspector shall brand with a rubber stamp on both ends of the cases inspected the name of the Inspector, the Exchange and the date inspected.

Following is a revised outline of the tentative U. S. grades of eggs adopted 1924 (U. S. Bu. Agr. Economics):

Four grades of eggs of sound clean shell are proposed, viz: (1) United States Specials; (2) United States Extras; (3) United States No. 1 and (4) United States No. 2.

Two grades of eggs of sound dirty shells are proposed, viz: (1) United States No. 1. Dirties and (2) United States No. 2. Dirties.

Only one grade of eggs of cracked shells is proposed, viz: United States Checks.

The condition of each quality factor which is permitted or required in eggs of each of these grades and the tolerance or number of eggs of a lower grade permitted in each grade is indicated in the following chart:

REVISED CHART OF TENTATIVE UNITED STATES EGG GRADES

GRADE	QUALITY FACTORS	CONDITION OF EACH QUALITY FACTOR
United States Specials: (A tolerance of 9 eggs below grade allowed in half case of which 2 may be loss	Shell	Clean and sound
	Air cell	Localized, regular, $\frac{1}{8}$ inch depth or less
	Yolk	May be dimly visible
	White	Firm and clear
	Germ	No visible development
	Size	Uniform
	Color and weight	(To conform to classification)

Revised Chart of Tentative United States Egg Grades—*Continued*

GRADE	QUALITY FACTOR	CONDITION OF EACH QUALITY FACTOR
United States Extras: (A tolerance of 10 eggs below grade allowed in half case of which 3 may be loss)	Shell	Clean and sound
	Air cell	Localized, well defined, regular, $\frac{1}{4}$ inch depth or less
	Yolk	May be visible
	White	Firm and clear
	Germ	No visible development
	Size	Reasonably uniform
	Color and weight	(To conform to classification)
United States No. 1: (A tolerance of 12 eggs below grade allowed in half case of which 4 may be loss	Shell	Practically clean and sound
	Air cell	Localized, regular, $\frac{3}{8}$ inch depth or less
	Yolk	May be visible and mobile
	White	Reasonably firm
	Germ	Slightly visible development
	Size	Variable
	Color and weight	(To conform to classification)
United States No. 2: (A tolerance of 5 per cent or 9 eggs as loss and 18 stained or slightly dirty eggs allowed in in half case)	Shell	Practically clean and sound
	Air cell	May be bubbly, freely mobile and over $\frac{3}{8}$ inch in depth
	Yolk	May be plainly visible, dark in color and freely mobile
	White	May be weak and watery
	Germ	Clearly visible development but no blood showing
	Size	Greatly variable
	Color and weight	(To conform to classification)
No. 1 Dirties	Eggs which are of the quality of United States No. 1 or better but are stained or dirty	
No. 2 Dirties	Eggs which are of the quality of United States No. 2 but are stained or dirty	
Checks	Eggs which are slightly cracked but with the shell membrane unbroken and not leaking their contents shall be classed as Checks. (Eggs with slightly leaking contents shall be classed as leakers. Those with contents flowing freely from shell shall be classed as smashed)	
Loss	Loss is defined to mean inedible eggs	

f. Packing. According to class and grade, sound eggs are packed in standard wooden cases containing 30 dozen each. For shipment, a bottom layer of excelsior, and a top layer of excelsior or corrugated cardboard are used to lessen breakage and to take up the slack. Fillers and flats are used in packing. These average about 51 ounces per case. Many styles of corrugated, fibre board and other styles of containers complying with postal requirements are used for parcel post shipments of eggs.

g. Storage. During March, April and May considerable quantities of eggs are packed in cases and placed into cold storage. All eggs at time of packing should be as fresh as possible, clean and sound. Cases, fillers, flats and cushions should be new, odorless and in good condition. Each filled case should have the lid secured properly. Storage rooms should be sanitary, odorless, dry, properly ventilated, with good air circulation, and maintained at an even temperature of 30 to 32°F. Malodorous substances, fruits and vegetables should not be stored in the same room as eggs. Lime may be used on floors and walls as an absorbent. Storage rooms if too dry will increase shrinkage of eggs due to evaporation of moisture, if too moist will result in the production of mould. One author gives the following humidities as desirable for egg storage rooms:

STORAGE TEMPERATURE	RELATIVE HUMIDITY
°F.	*per cent*
28	85
29	83
30	80
31	79
32	75
33	74

To aid air circulation cases should be piled on wooden strips with 2 inches clearance off the floor and with ½ inch strips between the cases.

The temperature should not go below 28°F. or above 33°F. Some establishments keep an even temperature between 31 and 32°F. It is stated that eggs laid in the Spring have a more dense albumen and can be stored safely at 28°F., while those laid in the summer have thin albumen which will freeze at that temperature.

The average shrinkage of properly stored eggs is 3 to 4 ounces per case per month in storage. Eggs may be held in proper cold storage in good

condition nine to ten months with an average loss of 1 to 1½ dozen per case for Spring packed eggs and 1½ to 3½ dozen loss for Summer packed eggs.

h. Shipment. A car may contain 375 to 400 cases of eggs. Cases should be arranged in a car in a compact manner to prevent shifting, resulting in breakage of eggs. During cold weather, straw or packing hay may be employed on the bottom, sides, ends and top of cars as an aid to prevent freezing.

2. Preserved Eggs. a. "Sterilized" Eggs. The so-called sterilized eggs or sterile shell processed eggs are produced by immersing fresh eggs for five to eight seconds in non-odorous mineral or vegetable oils or oil mixtures containing gums, resins or waxes, which have been heated to about 250°F. It is claimed that microorganisms present on or in the shell, and between the shell and egg membranes of strictly fresh, sound eggs, are destroyed; that by sealing the pores in eggs, ingress of odors, flavors and microorganisms are prevented; that loss due to moisture evaporation is reduced and that the storage loss is reduced about 50 per cent. All eggs to be treated first should be candled. After dipping, the eggs are cooled about forty-eight hours before introduction into a cold storage room.

b. Frozen Eggs. Small, dirty, heated, shrunken, cracked, leaky and other edible eggs of low market value may be broken and frozen for bakers' and confectioners' use. Since this product is very perishable, it is important that all eggs used are sound and of good quality, that all equipment and methods comply with strict sanitary requirements to prevent contaminations and that freezing is expedited to prevent bacterial growth.

The ceiling, walls, and floor of the egg breaking room should be non-absorbent. This room should have an abundance of fresh air and natural light. The egg breaking and other apparatus should be of metal or other material permitting of sterilization and absolute cleanliness. All equipment, including utensils should be cleaned and steam sterilized each day or upon becoming contaminated from an unsound egg. The clothing, hands and fingers of all breakers should be sanitary.

All eggs should be chilled below 40°F. for twenty-four hours, candled to eliminate all bad eggs and the sound eggs transferred at once to the breaking room to be broken and packed immediately, then handled into a sharp freezer without delay.

Each egg is broken on a specially constructed apparatus. The whites and yolks may be separated or the whole egg received into a sterile cup.

A smelling test is given each egg. Yolks and whole eggs are churned to produce a smooth, finished product. The whites, yolks, whole eggs or a mixture of whites and yolks are packed separately in sterile tin containers of 30 pounds net. Glass and crockery packages are liable to break in the freezing process. The tin should be of good grade and free from rust, otherwise a discolored product may result. The containers are filled to within 1 inch of the top and frozen at 0°F. or below. Covers then may be sealed or soldered on to prevent evaporation and the frozen product stored at 15 to 20°F. Frozen eggs should retain their initial condition for about one year.

Frozen eggs, usually can be produced with less than 5,000,000 bacteria and less than 10,000 B. coli per gram. One case of storage eggs yields about 16 pounds each of whites and yolks, while one case of fresh eggs yield about 18 pounds of whites and 16 pounds of yolks.

In shipping frozen eggs, the cars should be precooled properly and the eggs so transported that they are received in a hard frozen condition at destination.

c. Desiccated Eggs. Most desiccated eggs are produced in China. The eggs are candled, broken and separated into yolks and whites or used whole. Desiccation is accomplished by spreading the broken eggs in a thin layer over a heated cylinder, or on a belt and passing the product through a heated chamber, by heating in vacuo and by other methods. Salt or sugar may be added to aid preservation. The finished product is of low moisture content, has excellent keeping qualities and if properly prepared mixes readily with water.

d. Miscellaneous. Fresh eggs may be preserved in a solution of water glass or of lime water.

In the water glass method, 1 quart of sodium silicate may be added to 9 quarts of water which has been boiled and cooled. This amount of solution is sufficient to cover 15 dozen, sound, fresh eggs placed into a 5-gallon crock. The eggs should be covered with at least 2 inches of the solution. The filled crock should be kept well covered and stored in a dry, cool place.

In the lime water method $2\frac{1}{2}$ pounds of unslaked lime may be dissolved in 5 gallons of water which has been boiled and cooled. After settling, the clear supernatant fluid is decanted and used the same as stated above under the water glass method.

3. Army Requirements. The veterinary examinations prior to purchase, on receipt, during storage and at issue, and action as outlined for fresh meats, Chapter VIII, insofar as applicable should obtain for eggs. Current purchase specifications should be consulted.

Fresh eggs should be guaranteed by the dealer or shipper as to their freshness or condition as shown by candling. Doubtful eggs should not be accepted. An examination should be given the cleanliness, size, soundness of the shells and condition of the contents of eggs. A cracked egg gives a deadened sound when tapped lightly against a sound egg. Bad eggs sometimes may be detected by shaking of the contents, by being lighter in weight than normal, by floating in water, or as shown, by breaking. Eggs with damaged shells or if deteriorated should be rejected. Bad eggs are held to be adulterated food. A hatch spot in itself would not render an egg inedible. Whenever necessary to determine the condition of fresh eggs, the Army veterinarian should resort to candling.

CHAPTER XVI

Products Inspection (continued)

J. FISH AND SEA FOODS

1. Commercial Production. The species, habitats and methods employed in the acquirement of edible and poisonous fishes and other marine products are so varied and numerous that no attempt is made in this text to discuss them. For specific information along these lines reference should be made to available standard publications as are pertinent.

a. Fresh Fish and Sea Foods. (1) Fish. (a) Handling Newly Caught Fish. From the time fish are caught until finally consumed they should be handled, transported and stored under proper and sanitary conditions. Upon their removal from the water, fish should be chilled immediately and shipped as soon as possible to fish houses for packing. During cold weather open air refrigeration may be employed while during warmer weather recourse may be made to cooling fish with ice or chill rooms, or to artificial freezing. During warmer weather fish may be preserved in a chilled condition on board the fishing vessel, from the time of acquirement until landed at a fish packing house, and later for several days during the brief period of distribution and selling.

Fresh fish must be kept iced or otherwise in a properly chilled condition at all times after being taken from the water until they are consumed fresh or placed into cold storage. The best of care should be given fresh fish and absolute cleanliness is essential.

Evisceration. When caught, fish should be killed to prevent bruising and to retain the firm condition of the flesh. Bleeding sometimes is advisable. The fish may be transported round (undrawn) or as is sometimes desired, dressed at time of catching or on the boat bound for the fish house. The fish may be split and eviscerated or as obtains for some species, drawn out through the gill openings. Evisceration is said to retard putrefaction. It reduces the weight of a fish 15 to 24 per cent and in some instances wastes roe.

Initial Chilling. It is said that the keeping qualities of fresh water fish, to be consumed in a chilled condition, are lower if the slime on the

outside is removed by washing or if "sliming" is stopped by temperatures below 32°F.

Fish should be promptly and thoroughly chilled on shipboard before the initial packing in order that they will carry longer and in better condition with less ice. If facilities exist, the fish may be spread in a layer on a clean floor and covered with chiseled ice, or placed into a suitable cooler or ice box, prior to packing. They should not be placed in piles several feet thick as this bruises the fish and may heat them especially in warm weather.

(Permission United States Bureau of Fisheries)

FIG. 54. COREGONUS CLUPEIFORMIS

(Common whitefish of Lake Superior, Lake Huron, Lake Michigan, Lake Winnipeg, Lake of the Woods, etc.)

Initial Packing. Fish on shipboard should be placed into shipping packages as boxes or barrels without bruising, using a bottom layer of fine, chiseled ice, a layer of fish and then successive layers of ice and fish. Large and expensive fish may be eviscerated and cleaned, wrapped in parchment paper to exclude bacteria and to prevent evaporation, then packed in ice.

One method which has been used is to cool the fish in air at 32°F. ten to twelve hours, or sea water at that temperature for two and a half hours, packing the chilled fish in boxes without ice and keeping in a cold storage at 32°F.

Storage on Fishing Vessels. After catching, fish should be transported as soon a possible to a fish house for packing. This usually occurs in two to six hours. The storage room on a boat should be between 38 and

45°F. Between these temperatures, properly ice-packed fish may be held three to six days for the chilled trade, while two or three days is the longest fish should be held before freezing. It is said that large fish hold up better than small ones.

(b) Packing Chilled Fish. Fish packing houses and shipping barrels and boxes should be clean and sanitary to prevent contamination of the fish. Metal linings are desirable in chill store rooms. Usually fish are graded according to species, size and condition, and packed in flour barrels of 200 pounds capacity or shipping boxes holding 400 to 500 pounds of fish. Drainage such as edge cracks in boxes or augur holes in the bottom of barrels should be afforded containers for the water from the melted ice. Artificial ice is colder than natural ice therefore is better for long shipments as it lasts longer. However natural ice is more desirable.

In packing fish into a box, a layer of fine, chiseled ice is placed on the bottom then a layer of fish with heads to the ends of the box, a layer of ice in the middle, another layer of fish, then ice on top. Dressed fish may be packed on bellies, and round fish on backs, or as sometimes occurs no particular attention may be given the arrangement of fish in the packages. In a shallow box or during cold weather the middle layer of ice may be omitted. About 50 pounds of ice to each 100 pounds of fish packed in a box should be sufficient to carry a shipment of fish during summer for one to two days.

In packing fish in a barrel, a shovelful of chiseled ice may be spread on the bottom, then a layer of fish (about 50 pounds) and then successive layers of ice and fish until the barrel is full, with 3 shovelfuls of ice on top.

(c) Storage of Chilled Fish. Sound, fresh fish which have been packed properly in ice may be held in a storage room at 32°F. for ten to fourteen days. At this temperature the fish do not freeze and the ice does not melt.

(d) Shipping. Chilled fish in shipping containers may be shipped in refrigerator cars maintained at a temperature of from 38 to 45°F., the containers being spaced and banked with fine, chiseled ice.

(e) Freezing Fish. Fish crops are seasonable and as a matter of conservation, their freezing is conducted extensively at times of greatest production to provide a supply at seasons when such fish are not available to the fisherman. Fish, also are frozen to allow their transportation to distant points and for their preservation at destination for weeks or months. Three general methods of freezing fish are in use: the winter or natural freezing, the dry freezing and brine freezing.

Winter Frozen Fish. Winter caught fish secured on the edge of the ocean or through the ice are allowed to freeze naturally upon removal from the water. Some of these fish begin to freeze while still flopping on the snow or ice, freezing almost instantaneously resulting in twisted bodies. Such fish are always "round," retain a very fine, natural flavor and usually are disposed of before the following May.

Dry Frozen Fish. Fish may be dry frozen in a sharp freezer or by means of a salt and ice mixture in bins. Fish should be frozen as soon as practicable after leaving the water with as little handling as possible, otherwise they may become exposed to heat or to the sun, gashed, tramped on, bruised, and have the fins and skin broken, thus lowering their appearance and keeping qualities. Unless placed into cold storage within thirty-six to forty-eight hours after catching, fish may decompose especially in the region of the intestines.

Washing. Only sound, fresh fish in the best condition should be selected for freezer stock. Certain large fish and others with oily livers or heavily engorged with food may be eviscerated. Selected fish, round or drawn, are washed in long tanks in fresh, clear, cold water for the removal of dirt, blood and slime.

Sharp Freezer. After thorough washing, smaller fish are placed without delay into shallow, metal pans being arranged in neat rows. Usually a sufficient amount of water remains in a pan so that the fish freeze together in a compact block. Metal covers for pans sometimes are used.

The filled pans are placed directly on direct expansion pipes arranged in shelf formation in a sharp freezer maintained at -5 to -15°F. The larger fish are suspended in a sharp freezer or placed on thin metal trays in the freezer and frozen separately.

Freezing is accomplished usually in twelve to thirty hours according to the size of the fish and temperature of the freezer. Fifty hours are required for very large fish. It is stated that smaller fish shrink 2 per cent during the freezing process while large fish may shrink 3 to 6 per cent.

Salt and Ice Mixture. Instead of using a sharp freezer, covered pans of fish may be buried in a salt and ice mixture in bins, using 8 to 16 pounds of salt per 100 pounds of ice, and averaging 1000 pounds of ice per 1000 pounds of fish.

Brine Frozen Fish. In brine freezing, strong brine containing 17 to 20 per cent of salt, and which may be reduced in temperature to 10.4 to 6.8°F., without freezing, is placed into an insulated vat equipped

with refrigerating coils and an agitator. Smaller fish are washed, placed into wire baskets and immersed in the refrigerated brine while large fish are eviscerated, washed and suspended in the freezing solution. Freezing, takes place quite rapidly varying from $\frac{1}{2}$ to 6 hours according to the thickness of the fish and the temperature of the brine. It is said that there is no shrinkage attending brine freezing due to the instant freezing of the water adhering to the skin upon their immersion. This glaze also prevents any brine being absorbed during the freezing process.

It is said that fish frozen by the brine method will retain all the desirable qualities including the natural flavor, also the appearance, of fresh fish.

(f) Glazing. After proper freezing, fish are taken to a "glazing" room maintained at 20 to 25°F. Here the frozen blocks of fish and the larger ones which have been frozen separately, are momentarily dipped into clean, clear water maintained just above the freezing point, then removed. This results in the fish being incased in an air tight coating of clear ice about $\frac{1}{50}$ inch in thickness. Successive dippings may be conducted to produce a glaze $\frac{1}{32}$ inch or more in thickness. The increase in weight due to glazing varies, but averages about 4 to 5 per cent. Water used for glazing should be renewed frequently. Instead of dipping, frozen fish may be glazed by spraying them with cold water.

During subsequent storage this glaze prevents several deteriorative processes, viz., evaporation of moisture with loss of flavor; shriveling of the flesh; whitening of the skin, especially on nose and fins; entrance of air which tends to produce rancidity of fat; the bright red gills of fresh fish from turning dark or brownish and the eyes from shrinking and becoming opaque. The iced surface prevents mechanical injuries and the entrance of bacteria and moulds.

(g) Storage of Frozen Fish. After glazing, frozen fish may be stored at zero to 10°F., the cheaper grades being stored in bulk while the better grades are packed in boxes. Temperatures should be taken at the top of storage rooms. Large fish may be stacked in bulk or wrapped in parchment and brown paper and packed in wooden boxes lined with manila paper, while small fish are packed unwrapped.

Due to evaporation, the glazing on fish gradually disappears so that boxed fish should be re-glazed every three to four months. Frozen fish stored in bins in bulk may be re-glazed by spraying with a finely divided stream of pure water. The average storage period of frozen fish is six to eight months.

(h) Shipping Frozen Fish. Frozen fish should be shipped in properly precooled refrigerator cars, and delivered in a hard, frozen condition without the use of ice.

(i) Defrosting. Fish should be defrosted gradually in a cooler or refrigerator box and not exposed to heat or to soaking in either hot or cold water as this would lessen palatability and food value.

(2) Sea Foods. Fresh sea foods include clams, crabs, lobsters, oysters, shrimp, turtles, whales and others. It is essential that all fresh sea foods from the time they leave the water until finally consumed are chilled, handled, transported and stored under proper and sanitary conditions. Crabs may be kept alive three days after removal from water by packing them in shallow trays surrounded by damp moss or seaweed and covered with ice. Unshucked oysters may be washed, graded then transported and stored in barrels at about 38°F. but not in contact with ice, while shucked oysters should be shipped and stored in properly labeled, refrigerated packages. Shrimp should be sorted, thoroughly washed, packed in cracked ice and kept at cooler temperatures, or frozen to hold.

b. Cured Fish. Fish may be dry salted, pressed, pickled, dried, smoked or spiced in the production of cured fish. Codfish, mackerel, salmon, herring, haddock and many other species are cured.

Certain fish as haddock, codfish and others are bled as soon as caught to prevent congealing of the blood with discoloration of the flesh. Large fish with thin skin, soft fins and small scales are scaled by hand or in a rotary machine, while certain thick skinned, hard or spiney finned, and coarsely scaled fish may be skinned. Usually fish are split down the belly to the vent and the viscera and sometimes the head, fins and vertebrae, removed. Mackerel, lake herring and others may be split on one side of the back bone for the entire length of the back. Extra large fish may be split into two halves and these divided into two or more lengths.

The fish may or may not be washed and scrubbed in fresh, cold water or fresh brine and the blood near the back bone removed. Curing is accomplished as indicated above. Some fish are put down in dry salt in tight containers, cured ten days to three weeks and re-packed in 100° plain brine. It is essential that such fish be kept well covered with brine at all times while in storage. Dry salted and pickled fish may be washed, drained, dried, or smoked or subjected to a combination of two or more of these processes. The shrinkage of heavily salted fish is about 17 per cent of the life weight or 40 per cent of the dressed weight.

Certain cured fish are dried on trays in the sun or in a smoke house maintained at varying temperatures. The air drying shrink of fully pickled fish is about 9 per cent. Smoking of fish is conducted for different periods of time and at different temperatures, the color produced on the product being controlled principally by the density of the smoke.

For smoking, the fresh fish are thoroughly cleaned, and may be immersed in 35 to 45° brine two to ten hours, strung or placed on racks, allowed to dry, then smoked. Some fish are smoked two and a half to four hours beginning at 120°F. and finishing up the last few minutes at 275°F. Some varieties are smoked six to ten hours at 110 to 140°F. Ciscoes may be smoked two or more hours at 200°F. or above sufficient

(Permission United States Bureau of Fisheries)

FIG. 55. ONCORHYNCHUS TSCHAWYTSCHA

(Chinook, king, spring, tyee or quinnat salmon)

to cook the flesh. Prior to smoking, certain fish may be dipped in an approved vegetable dye simulating a smoke color. The smoking shrinkage varies considerably and is contingent to the kind of fish, whether fat or lean, round or drawn, and the length of time and temperatures of smoking.

c. Canned Fish and Sea Foods. The general processes employed in canning fresh or cured fish and sea foods including handling of the raw material, its grading, washing, dressing and further preparation for cans and other manipulations, do not vary materially from those as described for canned meats. (See Chapter X.)

A great variety of shapes and sizes of cans including tin and glass containers are used. The following sizes of tin cans were agreed upon

by the National Canners' Association in 1913 and are in use for many products:

HOLE AND CAP CANS	DIAMETER	HEIGHT	SANITARY CANS	DIAMETER	HEIGHT
	inches	*inches*		*inches*	*inches*
No 1 size	$2\frac{11}{16}$	4	No. 1 size	$2\frac{11}{16}$	4
No. 2	$3\frac{3}{8}$	$4\frac{9}{16}$	No. 2	$3\frac{7}{16}$	$4\frac{9}{16}$
No. $2\frac{1}{2}$	4	$4\frac{3}{4}$	No. $2\frac{1}{2}$	$4\frac{1}{16}$	$4\frac{3}{4}$
No. 3, $4\frac{7}{8}$ inches	$4\frac{5}{16}$	$4\frac{7}{8}$	No. 3, 4. inches	$4\frac{1}{4}$	$4\frac{7}{8}$
No. 3, 5 inches	$4\frac{1}{4}$	5	No. 3, 5 inches	$4\frac{1}{4}$	5
No. 3, $5\frac{1}{2}$ inches	$4\frac{1}{4}$	$5\frac{1}{2}$	No. 3, $5\frac{1}{2}$ inches	$4\frac{1}{4}$	$5\frac{1}{2}$
No. 10	$6\frac{1}{4}$	$6\frac{3}{4}$	No. 10	$6\frac{3}{16}$	7

(1) Canned Fish. (a) Anchovies. Anchovies 3 to 7 inches in length are canned similar to sardines. In some countries herring and young sprats are canned and put out as "anchovies." Generally each individual canner uses his own method to prepare anchovies. After washing, the fish are cleaned, the head and viscera being removed without splitting the abdomen. The bones and fins also may be removed. The fish are soaked in brine twelve to eighteen hours, drained, packed in kegs with fine salt and condimental spices, cured about fifteen days, re-packed in kegs and the kegs headed up. Anchovies for the retail trade are packed in olive oil in small tin or glass containers, and processed.

Anchovy paste is made by grinding or pounding boneless, skinned, pickled anchovies and mixing the product with flour, salt, salt prunella, spices, lemon peel and other condimental substances, and sometimes coloring matter. The paste may be canned immediately or cured as long as six months before canning.

(b) Codfish. Codfish may be canned fresh, corned, or mixed with corned haddock to produce "fish flakes."

Fresh cod is bled, the belly split, head, fins and viscera removed, and soaked one to four hours in fresh 50° brine to extract any remaining blood. Sometimes the fish then may be placed on trays in retorts to remove the excess moisture, after which the skin and rib bones are removed. The fish are cut into pieces to fit the cans, the cans filled, sealed, processed, etc., as described for canned meats. It is necessary to parchment-lined cans to be filled with codfish, to prevent discoloration of the product.

For corned cod, after evisceration, no water or brine is used, but the fish are dry cleaned, then rubbed with a curing mixture of salt, salt-

petre and brown sugar, cured two to four days in vats, the fish being weighted down, then washed, drained and canned as discussed for fresh cod.

(c) Fish Eggs. Fresh and salted roes of many fish may be canned. The melt or buckroe of certain male fish also may be canned for food purposes.

Caviar may be made from any kind of fish eggs, especially those from the sturgeon, salmon, paddle fish, white fish, lake herring, carp and others. The female or cow fish upon being caught may be bled, as by cutting off the tail. The roe is removed immediately, otherwise if allowed to remain in the fish for four to six hours, the eggs would become slimy, burst, develop an unpleasant odor or otherwise deteriorate. Hard roe is preferable to soft roe which usually requires so much salt as to render it unfit to eat.

The roe is placed on a fine meshed screen, having about 4 meshes to the inch and which is placed over a zinc lined trough or other container suitable for holding eggs. The roe is rubbed gently by hand on the screen and the eggs becoming loosened from the "membrane" drop through the screen into the container.

The eggs then are transferred to a barrel where about 5 to 7 pounds of a fine, pure table salt per hundred weight of the eggs are mixed by hand for five to eight minutes. The mass is allowed to stand ten to fifteen minutes after which the brine is poured off and the eggs placed on fine sieves to drain. This constitutes caviar. Drained caviar is packed in kegs, or canned.

Kegs from 135 to 160 pounds net capacity are filled, allowed to settle and the gas to escape, then filled to capacity and headed up air tight. Glass earthenware or tin containers may be used. Cans are exhausted, sealed, processed, etc., as discussed for canned meats.

(d) Herring. At the cannery the scales are removed by machine, the fish dressed by hand, washed thoroughly, excess moisture removed in a drying chamber, cans packed by hand with tomato sauce or oil, and spices added, cans sealed, processed, etc., generally as described for canned meats.

In canning kippered herring, the fresh fish are eviscerated, cleaned by soaking one to two hours in a strong brine, drained, smoked ten to twelve hours, packed into cans with an oil or other dressing, sealed and processed.

(e) Sardines. Any small fish of the clupeoid family and especially pilchards and young sea herrings may be used for "sardines."

After leaving the water, sardines should be dressed as soon as possible to prevent decomposition due to undigested copepods or "red feed." Some fishermen hold freshly caught sardines in nets a sufficient length of time for this food to digest, before landing the fish.

At the cannery the fish are washed and the scales removed in a rotary drum. The heads and viscera are removed and sometimes the bones after which the fish are washed thoroughly in fresh water, pickled twenty to sixty minutes in strong brine, drained and flaked. "Flaking" consists of placing the fish in layers on screens and boiling them for thirty minutes in cottonseed oil, or steaming them in live steam ten to fifteen minutes or until sufficiently cooked as shown by the tails being brittle.

After flaking the fish are drained and cooled, or the excess of surface moisture removed by drying in the open air in the sun or by being subjected to a current of warm air.

The fish then are packed in cans with olive, peanut or cottonseed oil, tomato or mustard sauce, vinegar or spices. The cans are sealed, processed, cooled, tested, rubbed clean with sawdust or put through a lye bath and packed in cases.

Smoked sardines are not eviscerated, but after pickling they are smoked thirty minutes, then cooked. The heads are removed before packing.

Clean, sound, broken fish and remnants or trimmings may be utilized in the production of sandwich paste.

(f) Salmon. Salmon may be canned fresh or smoked. Fresh salmon is canned in five different grades according to the different species of the fish, also as to locality, color of the flesh and part of the fish from which taken:

The five species are the chinook (king, spring, tyee or quinnat), sockeye (red, blue back or sukkegh), silver (cohoe, medium red or white), humpback (pink) and chum (dog or keta). The average weight of a chinook salmon is 16 to 22 pounds with a maximum of 70 to 100 pounds. The flesh is deep red, however white and mottled chinook salmon sometimes are found. The sockeye salmon average 5 pounds with a maximum of 12 pounds. They are considered the best salmon for canning, having a deep red colored flesh, a small amount of oil and other characteristics desirable for fancy packs. The silver salmon average 6 pounds with a maximum of 30 pounds and have a light red flesh. The humpback salmon average 4 pounds with a maximum of 11 pounds and have a pale colored musculature. The chum salmon average 8 pounds with

a maximum weight of 16 pounds per individual and have a pale, white or gray flesh of a mushy texture. This species is used principally frozen, salted or smoked.

The central cuts of fancy red salmon may be packed by hand in flat cans, 1 piece per can and sold as "salmon steak." The head cuts and tail pieces of the better grade of salmon, and species of a lower grade, may be packed by machine. The heads, tails, fins, viscera and debris from cleaning, are excluded from edible canned salmon.

(Permission United States Bureau of Fisheries)

FIG. 56. ONCORHYNCHUS NERKA

(Sockeye, sockey, sukkegh, red, blueback, or nerka salmon, or redfish)

CANNING SALMON

(From "The Salmon Fisheries of the Pacific Coast," by John N. Cobb. Pages 50–60. Report of the Commissioner of Fisheries, 1910)

DRESSING

The majority of the canneries still use the old hand method of dressing the fish, and in such places the selection of the butchering or dressing gangs is of prime importance. Two men constitute a "butcher's gang," and the number of these gangs is dependent upon the output of the plant. Boys place the fish, with the head out, upon the cutting tables. One man cuts off the heads, and is followed by another who removes the fins, tails, and viscera. The offal is thrown into a chute, when it passes into the water under the cannery, while the dressed fish is transferred to a tank of water, to be scaled, washed and scraped. It is then passed to another tank of water, where it receives a second washing, scraping, and final brushing with a whisklike broom, which removes any offal, blood, and scales that were overlooked in the first washing, after which it is removed to large bins on either side of the cutting machine.

The most useful cannery inventions in recent years have been of machines for doing the work of the dressing gangs. Several have been invented and work more or less satisfactorily. The one now in general use in canneries where such machines are employed was first used in 1903 at Fairhaven (now Bellingham), Wash. It removes the head, tail and fins and opens and thoroughly cleans the fish ready to cut into pieces for the cans. By the use of these machines the dressing gang is almost entirely done away with, dispensing with 15 to 20 men.

CUTTING

The usual method of cutting the salmon is by a machine. This is generally a large wooden cylindrical carrier, elliptical in shape, thus having a larger carrying capacity. Ledges or rests on the outside the length of the carrier are wide enough to hold the fish, and are slit in cross section through the ledges and outer casing to receive the gang knives. The latter are circular, fixed on an axle at the proper distances apart, and revolve at the highest point reached by the carrier and independently of the latter. The carrier and gang knives are set in motion, each revolving on its own shaft. As a rest on the carrier comes to a horizontal position, men stationed at the fish bins lay a fish on each ledge as it passes. Thence it is conveyed to the revolving gang knives and, after being divided, passes through on the downward course, sliding off the rest into the filling chute. The knives in these machines are so arranged as to cut the fish transversely in sections the exact length of the cans to be filled.

The rotary cutter shunts the tail pieces to one side, and these are carried by means of a chute to baskets. But few of the larger tail pieces are canned, the rest being thrown away, this forming a considerable part of the tremendous annual waste of the salmon canneries. As the tail portion is much smaller, with less meat, it can not be placed in the cans with the middle and head sections without detracting from their value, but if packed under a distinct and separate label, as is now done in a few canneries, there is no reason why the tails should not supply the demand for a cheap grade of fish.

In some of the smaller canneries, especially in those packing flat cans, the gang knives are worked by hand. In this case the knives are not circular, but elongated or semicircular in shape, tapering at the outer ends. They are mounted on an axle having a large iron lever at one end, and when this lever is raised the ends of the gang knives are thrown up and back. The fish is then placed in position under them and the lever pulled forward, the knives, with a scimitar-like movement, dividing the fish.

The original method of cutting was by means of a long knife wielded by a Chinaman who stood at a regular butcher's block. Although his strokes were increditably quick, the rotary cutting machine is a vast improvement over the old way.

SALTING

Every can of salmon is seasoned with one-fourth of an ounce of salt, which, to insure uniformity, is added by mechanical means. A table is used, in the top of which are holes equal distances apart. On the under side of the top is a sheet-iron plate, with an equal number of holes, which slides in a groove at the sides, and is worked either by a hand or foot lever. Just below is an open space large enough

to accommodate a tray holding 36 or 48 cans. A workman stands in front of the table and slides a tray of cans into the open space. He then throws a quantity of salt upon the table and immediately scrapes this off with a thin piece of wood, each hole being filled in the operation, and the salt being prevented from falling through by the iron plate underneath. The lever is then pressed, the iron plate moves forward until the holes in it are directly under the table top, when the salt drops through into the cans. This operation can be repeated four or five times in a minute.

FILLNG THE CANS

Most canneries now use filling machines, although a few, more particularly those packing flat and odd-sized cans, still fill by hand.

The filling machine consists of a chute with a belt to which are attached wire racks about 4 inches apart set at an angle to prevent the salt from spilling out, into which the salted cans are fed from the floor above and pass into the machine. At the same time the divided sections of salmon pass down another chute into the mouth of what looks like a hand coffee mill. They pass through here down a smaller chute and are forced by two dogs into a receptacle through which the plunger, or filler, passes. Here the plunger comes opposite the open mouth of the empty can, which when it reaches this point is caught by a clasp or hook and held in front of the plunger, which is immediatey thrust forward through a chamber filled with salmon, cutting the fish longitudinally and at the same time filling the can. The next movement forces the can out upon a table. When running at full speed one of these machines will fill about 80 cans a minute.

On being released by the clamp the cans roll upon a long table and are picked up by a man stationed here, who strikes each one upon a square piece of lead set in the table, in order to settle the contents down into the can and for the purpose of detecting any deficiency in weight. If not quite full the cans are pushed to the other side of the table, where a man adds the quantity of fish needed, a supply of small bits being kept at hand for this purpose. Generally the cans overrun in weight, frequently as much as an ounce. Occasionally a can is weighed in order to see that the machine is in perfect adjustment.

In the hand method the fillers stand on each side of a long table with a trough running down the middle from end to end. This is filled with the cut pieces of salmon, and the fillers, usually women and children, put into the cans large pieces at first and then smaller pieces to occupy the vacant spaces.

WASHING THE CANS

The cans are put upon an endless belt by a workman and pass from the filling-machine table to the washing machine. This is a rotating apparatus, consisting of an iron framework holding 10 rests or stands on which the cans sit. Immediately overhead are small perpendicular shafts with an iron cap, the diameter of a can, fixed to the end of each. Each can as it reaches the machine is caught by one of the washers and the cap brought down over the top, a tight-fitting flange preventing water from getting inside. Revolving rapidly as it goes, with a stream of water against it of sufficient force to remove the dirt and grease, the can is carried until the machine has revolved 180 degrees, when it is released and passes out on a belt. A more modern method is to use jets of steam for washing, while one of the latest

devices is to clean the cans by a cold-air blast which strikes directly on the top edge. A set of brushes against which the cans revolve is used in a few canneries.

After being washed the cans continue on an endless belt and pass two children whose duty is to put a small piece of scrap tin on the top of each. These pieces are called "chips," are from $1\frac{1}{2}$ to 2 inches, and are scraps from the sheet tin used in making the tops of the cans. The shape is of no particular importance so long as the pieces are long enough to cover the hole in the top of the can, or the cap as it is called.

CAPPING

The endless belt delivers the can to the capping or topping machine. On reaching this the can passes under a cap holding a top, the latter being fed in through a separate aperture, and the cap immediately falls with just sufficient force to put the top on the can without injuring either. The can is then forced out from under the capper by the rotation of the machine, and the next capper is brought around to receive another can. As the cans revolve they are carried under a crimper, situated directly opposite the capper, which presses the edge firmly around the body. While one can is being topped another is being crimped, after which it rolls out upon a belt on its side, and is taken through the acid trough. Before the tops are sealed the edges must be treated with a solution of muriatic acid, which is in a glass receptacle and is applied as the cans are rolled through the acid trough on the endless belt.

SOLDERING

For many years the tops and also all other parts of a can were soldered by hand, a long, tedious, and expensive process, which eventually gave way to the soldering machine. This is composed of an endless chain about 6 feet long, revolving around two shafts at either end of an iron trough. In the bottom of the trough is the solder, which is kept at molten heat by a row of oil blast jets underneath. Between the lower part of the chain and trough is just enough room for a can to pass without jamming, and they are forced along the trough by a chain in contact with their sides. They enter the trough at an angle, their bottoms slightly inclined, which causes the top rim to be submerged in solder, thus distributing it evenly all around the edge.

In passing through the trough the cans make about half a dozen revolutions, which cause the tops to become very hot, and it is to prevent them from being blown off by the pressure of the steam which quickly generates that the center hole in the top is made. The "chip" previously mentioned prevents the hole from beng choked with salmon.

A soldering machine having, instead of the endless chain to give motion to the cans, a metal spiral running the length of the machine and revolving on an axle through the center, is used in some canneries. Each loop grasps a can and follows it to the end, thus giving the cans the proper motion and preventing them from rolling side by side and lapping the solder over the ends, as is frequently the case with the chain machines.

A few canneries use a revolving cooler, which has a disk upon which the cans rest. This disk is filled with running water and after it makes two revolutions the cans are forced into an inclined trough under a stream of water. The usual

method, however, is for the cans on leaving the soldering machine to pass under several jets of water to set the solder and at the end of the belt to be transferred by workmen to coolers or crates, which are made of flat strap iron, square shaped, and hold about 96 cans. The crate having been filled, it is placed upon a square truck and rolled aside, where the vent holes are stopped with a drop of solder.

TESTING

The testing tank is a square wooden tank filled with water heated almost to the boiling point by steam pipes arranged in a coil at the bottom. The crates are hoisted into the test tank by a block and tackle attached to an overhead track, which permits the coolers to be swung to any place desired.

This test is for the purpose of detecting leaks due to imperfect soldering and is conducted by two workmen skilled in this operation. The slightest leak is detected by the appearance of small bubbles issuing from the cans. The spots where the bubbles appear are marked with a small iron tool held in the hand, and the cans are taken out and placed in small wooden trays, in which they are carried to the bench men, whose duty it is to mend them. Cans that have been mended are again tested as before. The bench men are located in front of a long bench on which are numerous fire pots, supplied with oil and air led through small tubes, in which the soldering irons are kept heated, the heat and air being regulated by connecting valves. Kerosene oil and gasoline are the fuels generally used now.

COOKING

The salmon are invariably cooked in rectangular retorts which rest in a bed and have a track running the long way. In front of each is a turntable for the purpose of receiving trucks coming from any direction. Four trucks each holding 6 crates of cans, piled one upon another, are run into the retort, which is then closed and steam turned on, entering at the bottom. The amount of pressure is from 6 to 12 pounds, the heat 250°F. In most establishments the first cooking is continued about 60 minutes.

After the first cooking the crates are taken out and placed on a long table called a "venting table," where the cans are pricked with a woodenheaded hammer fitted with a small brad, to allow the steam and superfluous water to escape. After the venting has been done the holes are soldered up, the crates again loaded on a truck and rolled into the second retort, where they are subjected to the same pressure of steam and heat as in the first cooking and for a period of about 60 minutes.

In some canneries the retorts for first cooking are made of heavy plank, well bolted to resist the steam pressure.

In the early days much secrecy and mystery was thrown about the cooking and the work was carried on in a separate room, known as the "bathroom," under lock and key. The first cooking was done in common tubs. The early retorts were made of wood. Later, round iron kettles were substituted, nearly one-half consisting of cover, and round crates were used for holding the cans.

For many years cannery men believed that the double cooking of salmon was absolutely necessary, but in 1898 Mr. F. A. Seufert, at his cannery on the Columbia River, at Seuferts, Oreg., a short distance above The Dalles, discarded this idea,

and has since used a one-cooking method. By the new process the cans are tested for leaks after the center in the top is soldered up, as before, and are left in the retort seventy minutes at 245°F. and 12 pounds steam pressure. According to its originator, this method saves more than one-half the labor in the bathroom, saves nearly one-half the labor in washing the cans after cooking, and also better retains the color of the fish.

SANITARY, OR SOLDERLESS, CANS

A recent improvement in the canning business, and one which accomplishes the same purpose as the single cooking retorts, is that of "sanitary cans," so called. In order to use these cans a quite radical, but economical, change in machinery is necessary. As the cans leave the filling machine they pass into a steam exhauster, consisting of a box about 30 feet in length, in which are three endless chain belts running side by side. Under and over each belt are steam coils, and under each

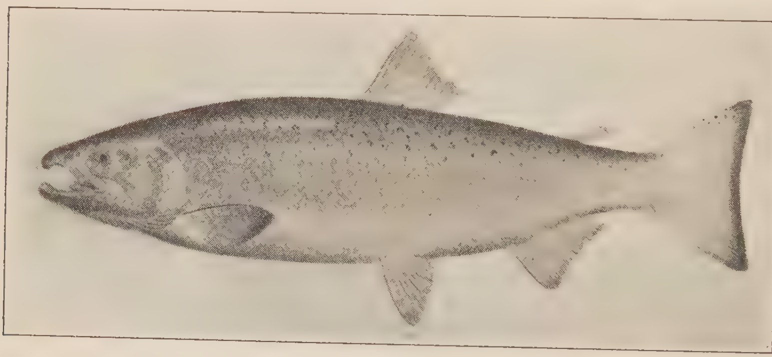


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Fig. 57. Oncorhynchus Kitsutch

(Cohoe, medium red, silver, silverside or white salmon)

of the lower coils are single pipes, which through small holes throw jets of live steam upon the coils, creating an intense heat. The cans pass along the first belt, are then transferred to the second belt, on which they return to the entrance of the box, whence they pass to the third belt, and continuing along this to the end pass out to the topper and crimper, the whole operation occupying five minutes' time. One style of exhauster has 10 ovals formed by the pipe, and the cans pass along these from side to side of the exhauster until discharged at the far end. By this means the contents of the can are heated and the greater part of the air exhausted, which is the object of the first cooling in the retort under the method in general use.

The topper and crimper is a circular machine with six rests for the cans. The first work performed by the machine is to "true up" the upper edge of the can, which is done by a plunger that presses the upper flange of the can upon a shoulder. In the meantime the top, which is coated around the outer edge with cement, has been automatically fed into the machine, is now clamped on the can, and by an-

other operation is crimped on tight. The cans then leave the machine on an endless conveyer and pass to the men who transfer them to the coolers, and these are immediately placed upon the trucks and run into the retort for the one cooking they are to receive. The time they are to remain here is somewhat variable, seventy to one hundred twenty-five minutes with a temperature of 242°F. being the common period.

By the use of these cans the soldering machine, and in fact all use of solder and acid, is done away with, a distinct sanitary improvement, for sometimes the substances would get into the can and cause a deleterious chemical change in the contents. It also does away with the first cooking and the subsequent venting and soldering, a saving both in labor and time consumed.

REPAIRING CANS

Imperfect cans which are repaired before the first cooking are naturally in the same condition as if there had been no defects. If the leaks are discovered after cooking and are repaired at once and the contents recooked, they are still very good, the only difficulty being that by blowing or venting them a second time they lose weight. The above goods usually go in with the regular pack of their kind and are not classed as regular "do-overs."

When, however, a cannery is running at full capacity, defective cans can not always be repaired and recooked at once and are sometimes set aside for days. Decomposition follows, of course, as with any other meat that is exposed to the air, and fish becomes unfit for food. When recooked the meat becomes mushy, and the blowing or venting makes the cans very light, a defect which is frequently corrected by adding salt water. This, the "do-over," is the lowest class of goods. In the old days, and even yet to some extent, such cans are sold without labels to brokers, or else are given some indefinite label, perhaps with the name of some fictitious cannery, and sold in the lumber, mining, or negro districts, or shipped to foreign countries with less fastidious tastes in the matter of salmon. In 1910 one of the leading companies of Alaska adopted the policy of throwing overboard all "do-overs."

On coming from the second retort the crates are lowered into a bath of lye, or, as in some canneries, the cans are run through such a bath on an endless belt, which, with the aid of a slight rinsing and a few rubs with a brush over the top, removes from the can all the grease and other material, and then passes them into another bath where the lye is washed off in hot fresh water. The cans then go to the cooling room, where a stream of water is played upon them, or, during rainy weather are placed out of doors upon the wharf, and there allowed to cool.

The top and bottom of the cans contract in cooling, and for several hours a sharp popping noise is head. Here, as in nearly every process through which they pass, the cans are again tested, this time by tapping the tops with a small piece of iron about 6 inches long, or sometimes, a 12-penny nail. The sound conveys to the ear of the tester an unmistakable meaning as to the condition of the can, and the faulty cans that escape notice during the other tests are invariably found in this one.

LACQUERING

An almost universal custom in the salmon-canning industry, but one that is not common in the canning of vegetables, fruits, etc., is that of lacquering the cans. This idea of protecting the can on the outside has been followed from the very beginning, for two reasons: (1) That the English market which, at that time especially, absorbed the greater part of these goods, insisted on their shipments being finished in this way, and (2) from the fact, as these canners speedily found out, that if they did not protect their cans in some way enormous losses through rust would ensue.

The first experiment of this nature was to paint the cans by hand with red paint, treating each singly. Next a composition of logwood extract and alcohol was tried, which, however, did not produce satisfactory results for a very plain reason—the can was dyed instead of being lacquered. The next attempt was to varnish the cans with a japan varnish reduced with alcohol, but this was found to dry too slowly for speedy handling. After extended experimentation the quick-drying brown lacquer of the present time was evolved, which carries asphaltum in the form of an asphalt varnish as its base, this being supplanted in some cases by gilsonite. This lacquer can be procured in either a heavy or light body, is generally reduced with benzine or gasoline, and is applied according to the requirements of the market, which in some localities demands a heavy coating and in others a much lighter finish, the latter giving a rich golden brown color. Some experiments have also been made in using brighter colored lacquers for this work. Several of these, made to give a bright golden, copper, or other color, are extremely attractive in appearance, while at the same time protecting the tin against rust quite as well as the brown.

The industry soon outgrew the hand method of lacquering, and the process which for a number of years was universal in the trade, and is still used by some canneries, succeeded it. For this there are a number of rectangular box vats about 40 by 80 inches and 18 inches in depth, the number varying with the capacity of the cannery. These are usually lined with galvanized metal and provided with a gridiron-shaped iron frame, hung from a windlass or other tackle for lifting or lowering from top to bottom of the vat. The cans are loaded on this gridiron, being placed in an inclined position to allow the draining of the lacquer, and are lowered in the vat sufficiently to submerge them in the lacquer with which the vat is charged to a depth of 7 to 10 inches. The loaded gridiron is then raised to the top of the vat and the cans allowed to drain and dry before piling. This method, while being more effective in regard to the volume of work, was still of necessity a very slow and tedious operation. In damp or rainy weather, especially when it is not possible to open warehouse doors and windows, the gas arising from a number of these vats makes effective drying almost impossible.

Another principal objection to this method of lacquering, which applied also to all earlier attempts, was the impossibility of obtaining an even coat of lacquer when the can was allowed to dry in any stationary position. There was also a large waste by evaporation.

Notwithstanding repeated efforts at invention, however, it was not until 1901 that an effective machine for handling this difficult work was put on the market. The apparatus now in use by a number of canneries receives the cans on a revolv-

ing wheel fitted with rests for holding them while passing through the lacquer bath. From here they roll upon an endless chain which revolves the cans as they pass through a long box in which a hot blast dries them before they reach the end of the machine. The rotating or rolling motion given to the can after the lacquer bath, preventing the lacquer from draining to and consequently accumulating on any part of its surface, also has the effect of distributing the lacquer evenly and results in a clean and neatly finished can. The air blast facilitates the work of drying to such an extent that it requires only about two minutes after being deposited on the drying bed of the machine for the cans to be ready for handling, while the quantity of cans which can be handled in a day is vastly greater than by the old method.

A few flat and oval cans are not lacquered, but are protected from rust by wrapping in tissue paper, over which the label is placed.

LABELING

While machines have been made for this purpose, and some of them are in use, the work is usually done by hand. A number of men seat themselves about 4 feet apart in front of the pile of cans. Each man has in front of him a package of several hundred labels, and by bunching them on a slant so that successive margins protrude beyond each preceding, he can apply paste to the entire number with one stroke of the brush. A can is placed on the label, is quickly rolled, and the label is on much quicker than one can tell it. Each man places to his right the cans he labels, forming a pile of length and width equal to his unlabeled pile, and when the entire lot has been labeled it has been shifted only about 4 feet. Cans of fancy brands of salmon put up on the Columbia River and in the Puget Sound region are wrapped in colored tissue paper before the label is put on. Cartons similar to those used by the sardine packers would make good containers for fancy brands and would be much cheaper than the present method.

Several attempts have been made to popularize salmon packed in glass and porcelain jars, and while these have met with some favor, it was not sufficient to warrant a continuance of the practice for any length of time. None are being so packed at the present time.

BRANDS

A very important feature of the canning industry is the selection of appropriate brands or labels for the various grades of salmon. Each company has a number of these, which it has acquired either by designing them or by absorbing another company which owned them. A well-known brand has a value in itself and sometimes is a very important asset. A company will sometimes market a considerable part of its product in one section, and here, where the consumer has become familiar with the brand and pleased with the contents of the can, he will ask for and accept no other, despite the fact that the latter might be, and probably is, the equal of the product he has been using.

Up to a few years ago one of the most serious evils in the trade was the use of misleading and lying brands. The high-grade product would almost invariably be correctly and fully branded, but "chums" and "pinks" were usually branded as "Fresh salmon," "Choice salmon," etc., which would deceive all persons but those

well acquainted with the industry. "Do-overs" and very poor fish were usually marketed under a brand which bore the name of a fictitious company or of no company at all.

The passage of State laws of varying degrees of efficiency governing the branding of salmon helped slightly to remedy this condition of affairs, but it was not until the Pure Food and Drugs Act, approved June 30, 1906, was put into force by the Government that any radical improvement was noticeable. At the present time but few misleading brands are in use.

BOXING OR CASING

A case of salmon generally contains 48 one-pound cans or their equivalent, i.e., 24 two-pound cans or 96 half-pound cans. Some canneries pack their half-pound cans in cases of 48. These cases are usually made of wood and cost from 9 to 11 cents each knocked down.

CAN MAKING

Some of the canneries in the Coast States purchase their cans ready made, but the usual method is to purchase the sheet tin and make up the cans in the canneries. This is especially necessary in Alaska, as it would be impossible to find room on the cannery ships for such a bulk as they would make in addition to the other supplies necessary. Furthermore, the making of cans provides work for a large part of the crew, otherwise unemployed while the rest are getting ready the other necessary paraphernalia. The work is done by machinery and occupies several weeks' time.

Fresh salmon may be dressed, cleaned, cut into pieces, washed, soaked in brine one to two hours to remove blood, pickled twenty-four hours using a hot vinegar and spice pickle, then canned. Fresh, mild cured or hard salted salmon may be smoked, cut into pieces or thin slices and canned.

(g) Tuna. Tuna fish are canned principally in Southern California. Tuna include the long finned or albacore, the leaping, yellow fin and striped tunas. The fish should be bled and dressed when first caught. At the cannery the fish are washed in brine then in fresh, cold water and hung on racks over night for blood drainage, in order to promote a bright color to the finished product. Then the fish are placed on wire meshed pans, placed into retorts and cooked under live steam for about two and a half to three hours to loosen the skin, render out the oil and soften the flesh. The cooked fish are cooled ten to twelve hours in a chill room equipped with fans, then taken to the cutting room where the fins, tails, skin with its subjacent layer of dark meat and the vertebrae and other bones, are removed. The white meat is cut by machine into pieces as will fit the cans. The cans are filled by hand, with about $\frac{1}{8}$ ounce of salt per pound of fish, and olive or cottonseed oil, added. The cans then are sealed and processed.

The dark meat and scraps of white meat may be ground, and canned to produce deviled or potted tuna, while the refuse is used for fertilizer.

(2) Canned Sea Foods. (a) Clams and Clam Products. The kinds of clams used for food include the hard, surf, razor, soft, little neck and butter clams. Clams for canning are conveyed through vats of boiling water to open the clams. The meat is extracted by hand or machine; quickly cooled by jets of cold water; split with scissors; dark mass on the near end of the siphon and most of the siphon cut off, and all dirt, sand and other debris removed; the meat washed in a rotary washer and the whole clams filled into cans and hot brine added. The cans then are sealed, processed, etc., as for canned meats.

Instead of canning them whole, after cleaning and washing, the clams may be run through a grinder and canned to produce minced clam.

The surplus liquor from canning may be canned for clam nectar.

Clam juice or extract is prepared by steaming clams in a retort, then filtering, concentrating and canning the juice obtained.

Clam broth is prepared by placing fresh clams and celery into cold water, boiling for ten minutes, adding salt, pepper and a small amount of butter, straining and filling hot into inside-lacquered cans, which are sealed, lacquered, etc., as described for canned meats.

Clam chowder is prepared from clams, salt pork or bacon, vegetables and condiments, properly cooked and canned in inside-lacquered cans.

(b) Crab Meat. There are two kinds of canned crab meat on the market in United States, the hard shelled blue crab and the Japanese packed spider crabs.

Crabs are received at the cannery alive in barrels, and may be kept three days if transferred to shallow boxes and covered with moist sea weed or moss. For canning, crabs are washed and sorted. All dead, small, moulting or other crabs unfit for canning, are rejected. The crabs then are boiled in a solution containing $\frac{1}{4}$ pound of bicarbonate of soda per 5 gallons of water. The water used should be free from sulfur and iron. After boiling, the crabs are washed in cold water and sent to the picker's bench where the outer shells and entrails are removed and the meat stripped. For deviled crab, the muscles and skin of the claw are termed "claw meat;" the muscles which operate the legs or back fins, "lump meat" and the muscles from the remainder of the body, "white" or "flake meat."

The meat is washed in 1 per cent brine, drained and packed into cans using $\frac{1}{4}$ ounce of salt to each pound of meat. For soft shelled crabs a 3 per cent brine is used. Whole crabs infrequently are canned.

The filled cans are sealed, processed, and otherwise handled as described for canned meats.

Shells. Back shells of crabs are washed, sun-dried, packed in cartons and sold for serving purposes.

(c) Lobsters. At present, canning of lobsters is conducted principally in Canada. The live lobsters may be held in pounds until ready for use, or canned as soon as caught. They are sorted, all dead ones being excluded. They may be boiled alive in 3 per cent brine for thirty minutes, or first killed before boiling by cutting at the joint where the body shell and tail come together. After boiling, they are cooled in cold brine of 6 per cent strength. The pickers then break off the claws and tail, split the body and tails ventrally, remove the viscera, crack the claws and pick the meat out of the body and claws by hand. The meat is filled into cans or glass jars. Cans are paper lined to prevent the corrosive action of the phosphorous in the meat on the metal with blackening of the product. A small amount of salt or brine and sometimes condiments, may be added. The cans are sealed, processed and otherwise handled as described for canned meats.

(d) Oysters. Fresh, unshucked oysters are washed free from mud, culled and sorted into grades, 800 to 1000 per barrel are called "standards," 600 to 800 "selects," 450 to 600 "extra selects" and less than 450 "counts" or "plants." Usually only the smaller ones are canned. Oysters are steamed ten minutes at 240°F. or until sufficiently open for shucking. Each bushel of oysters yields about 50 ounces of "solid meats."

The shucked oysters are washed with 1 per cent brine under agitation. Broken, torn and discolored ones are excluded. The oysters then are weighed into cans according to grade and the cans filled with a hot, weak brine containing $2\frac{1}{2}$ pounds of salt per $12\frac{1}{2}$ gallons of water. The brine added should not be in excess. The cans are capped, processed and otherwise generally handled as described for canned meats. Any canned oyster is called a "cove" oyster.

(e) Shrimp. After catching, shrimp are sorted to exclude those which are small, soft or damaged; washed to remove slime and dirt; and canned as soon as possible. Large shrimp or "prawns," 5 to 7 inches long, are desirable for canning. When properly packed in ice, shrimp may be held eight to ten days in cold weather or two to three days in warm weather. At the cannery, they are cleaned or "peeled" by hand, the entrails, shell and head being removed and the tail meat retained; washed in 2 or 3 changes of fresh, cold water and blanched by cooking

in boiling brine containing 1 pound of salt per gallon of water. Shrimp intended for wet packing are cooked about five minutes while those for dry packing are cooked longer. Upon cooking, the whitish-gray meat becomes pink or red. After blanching, the shrimp are spread on trays to cool. Here they are resorted to remove any remains of entrails, legs, antennae and shells. Shrimp intended for dry packing are allowed to drain and dry, the latter being expedited if necessary by means of fans.

The cooled shrimp are weighed and hand packed into cans. Wet packed shrimp have brine added while cans for dry packed shrimp are lined with parchment liners. In the dry pack method, it is essential to prevent contact between the shrimp meat and the tin of the container,

(*Permission United States Bureau of Fisheries*)

Fig. 58. Oncorhynchus Gorbuscha
(Humpback, pink or gorbuscha salmon)

as by use of parchment liners, otherwise blackening of the shrimp may ensue due to a reaction between the sulfur in the shrimp and the iron of the can.

After filling, the cans are sealed, processed and otherwise generally handled as described for canned meats.

2. Army Requirements. The veterinary examinations of fresh, cured and canned fish and other marine products prior to purchase, on receipt, during storage and at issue and general action to be taken, are along the same general lines, where applicable, as outlined under Chapter VIII, Fresh Meats, Chapter IX, Cured Meats and Chapter X, Canned Meats, respectively.

a. Fresh Fish and Sea Foods. (1) Fresh Fish. A knowledge of the species of available, edible fish and their season of greatest production are desirable. Usually, poisonous fish are not handled by reputable fish dealers.

NOTES CONCERNING POISONOUS FISHES

(*H. F. Taylor, Bureau of Fisheries*)

It appears to be true that poisonous fishes are much commoner in tropical than in temperate waters, and that fishes that are harmless and a regular article of diet in the latter may be regularly or frequently poisonous in the former; that certain species are constantly and always poisonous, and that others only occasionally cause sickness. The members of the family Tetradontidae (puffers, swell toads) are looked upon generally as poisonous in tropical waters, while several others are said to be occasionally poisonous. In the book by Gatewood there is list with illustrations, mentioning the toxic characteristics of many fishes.

The causes of poisoning by fishes are diverse (no account is taken here of venomous fishes that inflict with their teeth or spines poisonous wounds). It appears that some people exhibit idiosyncrasies in this respect; in such there appears to be an inability to digest fish, due, it is said, to a deficiency of hydrochloric acid in the gastric juice; violent digestive disorders, such as acute indigestion, may follow a meal composed of fish. In other cases, the oil in the fish is an obstacle to digestion.

Some fishes, not themselves, poisonous, may transmit poisons through their food to persons eating them. This is alleged to be true in the West Indies where fishes eat the manchineel fruits. Other foods, sometimes poisonous to man, but apparently harmless to fishes, include molluscs, zoophytes, corals, medusae, holothurians and protozoans. Fishes that live in putrid detritus may undoubtedly convey some poison to man. This case is unlikely, however, in open sea water. The deliberate use of poisons to capture fish, such as fish berries (Cocculus indicus), may cause poisoning in this class, though it is not known that persons have been actually poisoned from this illegal method of capture.

The most important cause of poisoning by fish relates to cases where the meat of the fish is in itself poisonous. There are two important subdivisions of this general class; first, inherently poisonous and second, flesh which acquires poisonous quality after death of the fish. In the former subdivision, certain fishes, (Tetradons) undoubtedly belong. The poisons are called "leucomaines" or animal alkaloids that are normal and physiological in the fish, and represent no derangement. The poisons seem to be concentrated in the genital organs, viscera and surrounding tissues, especially during the breeding seasons. They are violent poisons causing death in a short time. They are also distributed to a lesser degree in the flesh of the fish. It is possible that other chemical poisons, possibly cynates, exist in other fishes, especially the liver, of certain selachians.

The other subdivision of this class of poisons relates to poisonous quality developed after death of the fish, and the opinion is general, though not unanimous, that the poisoning by the barracuda is of such a nature. It appears almost certain that poisoning by Carangidae is of this kind. Fish flesh may spoil very readily, especially in tropical climates, and when slightly spoiled contains the so-

called "ptomaines," or substances of a putrescent origin. The degree of poisonous quality may vary from mild to very great virulency. A close examination of the methods of handling may reveal that the fish are not properly chilled, or are otherwise improperly handled, so that opportunity arises for this decomposition to occur. In tropical waters every effort should be made to ice the fish immediately upon capture and keep them at ice temperature at all times, and also to shorten the time between capture and consumption as much as possible.

The markets should be rigidly supervised so that their fish are never exposed to warmth at any time. One method that has been used to prevent "ptomaine" poisoning consists of dropping the freshly caught fish into boiling water, thus cooking it. It will then keep under moderate precautions until eaten, better than raw fish.

Poisoning by fish is called in the West Indies "Ciguatera;" in the Philippine Islands the name for the puffer "botete" has become the general name for poisoning by fish. Poisoning by inherent fish poisons is called "ichthyotoxism."

During the frequent mortalities of fishes in the West Indies, many fishes are found afloat, recently dead, and apparently good. Cases are known where such fishes have been eaten. Needless to say, this practice is extremely dangerous, for there is no means of knowing how long the fish have been dead, and the looks of a dead fish afford no necessary indication of its chemical constitution. Perhaps such dead fish may be taken intentionally or unintentionally. Every effort should be made to prevent their being taken at all.

All fish are in the best condition just before spawning. A full, meaty abdomen is desirable in salmon. Fish may be undrawn (round) or drawn. Drawn fish have the viscera removed. The gills, head, scales, skin, fins, tail, vertebrae, and blood in the large vessel beneath the vertebrae, may or may not be removed. (See purchase specifications.)

It is essential that strict sanitary measures are employed throughout in the washing, cleaning, dressing, icing, packing, shipment, storage or other handling accorded edible, fresh fish as well as all compartments, carriers and equipment involved. Water, ice, salt and brine used for washing and chilling purposes should comply with all sanitary requirements of the Surgeon General.

Because of the great danger of injury to man through ingestion of putrefactive fish poisons, fresh fish should receive a very rigid inspection. Fresh fish should be sound, clean, free from contaminations and unauthorized chemical preservatives and properly iced or frozen.

In sound, chilled fish in good condition, usually the mouth and gills are closed, the gills are bright red and free from offensive odor, the eyes are prominent and transparent, the skin is shiny with little or no slime, if slime is present it is creamy white, the scales strongly adhere to the skin, the flesh is firm and elastic, finger impressions do not remain, the tail does not droop, rigor mortis is a favorable sign, and the fish

sinks in water. A fish having all of its fresh qualities is termed "bright."

Stale or decomposed fish may show one or more of the following conditions which vary according to the extent and cause; usually the mouth and gills are open or easily opened; the gills have lost their fresh color and are pale, yellow, dirty, greyish red, brown, dark red or otherwise off color, slimy and with an unpleasant or bad odor; the eyes are red bordered, sunken, untransparent, opaque, and the cornea dull, disintegrated or absent; the skin is covered with slime, is "spotty," the slime may be yellowish or greenish and with an offensive odor; the scales are easily removed, loose, and may have a bad odor; the flesh is soft, easily removed from the bones, withered, flabby, pits on pressure, pale, may have a bad odor and a distinct alkaline reaction; the tail droops; the blood especially in the large vessel inferior to the vertebrae, has lost its bright color and may have a bad odor; the fish floats on water and the belly may be discolored and flatulent.

Decomposition first may be noted by opening and smelling the gills, second by examination of the blood in the large vessel just beneath the back bone and third in the digestive tract, if present. Yellow pike may have a characteristic gill odor which should not be confused with sourness. Approaching staleness in the halibut may be indicated by roughness of the skin. When one fish is found stale or decomposed, frequently the entire lot is affected, thus requiring a very thorough inspection. Fresh fish, which have been wrapped in paper and stored under chill temperatures, develop unpleasant odors due to decomposition of the slime. Certain fish which have not been bled or the excess of congealed blood removed by proper preparation, may have lowered keeping qualities.

Parasites sometimes found in fish include internal and external parasites as leeches, flukes, tapeworms, nematodes, protozoa and others. Fungus diseases frequently are found. Halibut may be "mushy" or "wormy" when infested with a small parasite called "chloromyxum hippoglossi." The flesh may be so infested by myriads of this organism, that it appears riddled or filled with small holes and contains white, opaque or lardaceous deposits.

The soundness of frozen fish may be determined somewhat by breaking the fish in two and noting the odor. When fish have been frozen at a low temperature and stored at a temperature just below their freezing point (31°F), oil from fat cells may ooze out beneath the skin and become rust colored and rancid. When this discoloration is well marked or

extends into the meat, the fish should be rejected. Fish should not be defrosted until used. Defrosted fish should be inspected along the same lines as fresh, chilled fish.

Fish which were dead before capture, and suffocated fish, should be rejected. Fresh fish also should be rejected, when of an inedible or poisonous variety; when handled or stored under insanitary conditions; when contaminated, injured, stale, decomposed, deteriorated, bloated, emaciated, affected with nematodic infestation of the musculature, myxosporidiosis, measles (infested with Bothriocephalus latus larvae), or other animal parasites; fungus or bacterial diseases; preserved with

(Permission United States Bureau of Fisheries)

FIG. 59. ONCORHYNCHUS KETA
(Calico, keta, dog, chum or fall salmon)

unauthorized chemicals; otherwise unsound, or not up to purchase requirements. Due consideration should be given natural odors if not repulsive and pigmentations peculiar to some varieties of edible fish.

(2) Fresh Sea Foods. After cooking, lobsters and crabs tend to decompose rapidly. Lobsters cooked before death have the caudal extremity recurved toward the abdomen and the caudal meat can be removed intact. This does not obtain for those boiled after death. Crabs cooked after death are distended.

Pink oysters due to "red feed;" shucked oysters showing an excess of moisture, and oysters packed in direct contact with ice, are undesirable. A dark or black ring on the inside of a shell indicates decomposition. Dead clams and oysters may show open shells. A "clucker" is an unshucked oyster or clam which has dried out. Upon being tapped, a clucker emits a "dry" or hollow sound.

Oysters should be rejected when of insanitary source, or if decomposed, water-soaked, adulterated with water or copper salts or otherwise unsound or undesirable. "Grass" green colored oysters, due to having been placed into a solution of copper acetate, will, upon the addition of vinegar, cause an incrustation of a metallic copper lustre on an inserted iron fork or needle; and, with the addition of ammonia, become dark blue.

b. Cured Fish. These should be inspected along the same lines as cured meats. Water used in making brines should be pure, clear, free from iron and comparatively soft. The desirable maximum limit of total hardness is about 150 parts per million. Salt should be pure and without an excess of magnesium or calcium sulfate. Salt should not contain more than 2 per cent of lime. Spices and other authorized ingredients used should be sound. All containers and methods should be sanitary and efficient. When fish in pickle cure project above the brine, a red or a rust discoloration may result. In air drying salted fish, they should be protected against dust, dirt, flyblows, sunburn, rains, dews and softening.

The veterinary examination of cured fish is made for contaminations, decompositions, deteriorations, substitution of one species or variety for another, misbranding, use of unauthorized preservatives and for diseased conditions.

Dry salt cod may become pale pink to deep red due to some chromogenic organism as "Clathrocystis," Bacterium halophilicum or Spirochaeta halophilica gaining access through unclean methods, equipment or contaminated solar salt. Cured fish exposed to the air may become rusty due to oxidation of the oil. Samples of fish should be broken open and odor noted. All unsound cured fish should be rejected. Purchase specifications should be consulted.

c. Canned Fish and Sea Foods. The veterinary examinations of canned fish and sea foods where applicable, are along the same general lines as outlined in Chapter X, "Canned Meats." Such examinations of canned fish and other marine products intended for Army consumption should commence as soon as the fresh products are received at canneries, and include an examination for soundness of all ingredients used; the sanitary supervision of, and methods employed in the dressing, washing, cutting, cooking, boning, and sorting of meats; the cleanliness of cans, their stuffing, weighing, sealing, vacuum and sterilization; examination of the finished product prior to and at time of purchase including testing for defective cans; examination of lacquering and label-

ing; weighing, packing or other manipulation, handling, storage, receipt and issue with such re-inspections as are required. It also includes the sanitary location, construction, equipment and methods of operation of establishments involved as defined in Army Regulations (See Chapter III, Handbook). Veterinarians engaged in the inspection of canned fish or sea foods should be familiar with all of the sanitary requirements of Surgeon General, of the national and state pure food laws relating to authorized ingredients, labeling and weights, and of all procurement specifications.

(1) Canned Fish. (a) Salmon. At the cannery, the species as specified is selected. Freshly caught salmon, not more than twenty-four hours from time of catching, with full meated abdomens, sound and free from injuries from pews or other agencies, are desirable. Dressing and other processes should comply with all requirements. In packing cans, the parts specified should be used. Gills, fins, viscera, blood clots, and tail pieces are not desirable. A vacuum of not less than 6 inches is desirable and preferably 9 inches or eight minutes at 212°F., otherwise upon shipment to a warm climate, springers may develop. Processing should be sufficient to soften the bones.

In the inspection of a lot of canned salmon for purchase the veterinarian generally should be guided with the technique as outlined under veterinary examinations of canned meats prior to purchase, Chapter X. In the veterinary examination of selected samples for soundness as well as specification requirements, the following may be used as a guide: The inspection room should be free from odors, smoking should not be permitted and inspection should not be carried on for too long a time, otherwise the sense of smell may not be able to function properly.

A thorough external examination should be given each can as to type of can used, size, construction, embossing, labelling, lacquering, soundness and weight. Note should be made of the data appearing on the label, as to grade, contents, name, and address of packer or distributor, the net weight of contents and date of packing. Canned salmon always should be labeled and have one of the common names stated on the label. "Do-overs" are not desirable. Generally, one pound tall cans and one pound flat cans should weigh, gross, 19½ ounces; and ½ pound flat cans, gross, 10½ ounces.

The can should be opened by inserting the can opener adjacent to the seam just below the top and cutting away from the seam around the can until the seam again is reached, so that the entire top may be turned back and the contents removed intact.

The odor should be noted, whether characteristic, normal, abnormal, old or due to processing of decomposition.

(Permission United States Bureau of Fisheries)

FIG. 60. BLUE CRAB

The amount and color of the oil should be noticed. Sockeye and chinook salmon have a large amount of rich, bright red oil; medium red and humpback salmon a lesser amount of orange colored oil; and chum

salmon a small amount of yellowish-orange colored oil. Canned salmon rich in natural oil usually is more palatable than one which is lacking in this respect.

A small hole should be made in the bottom of the can, the contents emptied into a tared dish and the odor of the inside of the can immediately determined. Next determine the net weight.

The soundness and quality of the pack should be ascertained to see if watery, mushy, decomposed, or containing fins, tails, scales, viscera, blood clots or other parts. The contents of cans subjected to rough handling may be soft and broken up. The musculature should be firm, of good size, texture, color and odor. The flesh of the sockeye, chinook and cohoe is quite firm; that of humpback salmon more soft; while that of chum salmon may be quite soft or mushy. Soft salmon is undesirable. It is preferable to have the salmon in a can to consist of one piece. The size of pieces is indicative of the kind of salmon. Sockeye flesh is closely knitted, chinook meat occurs in large coarse flakes, that of cohoe is medium in texture, of humpback salmon fine-grained while that of the chum is coarse-grained.

The meat of the sockeye is blood red, of the chinook either slightly more pale (or even white), of medium red salmon a pinkish-red, of humpback salmon a buff-pink while that of chum salmon is yellowish or greyish-white. Brown, discolored or black spots may be due to injuries from pews, congealed blood or to decomposition prior to canning.

A piece of musculature should be kneaded in the hand and odor noted. If apparently sound, the sample may be tasted.

It is desirable that bones be soft as this is indicative of proper processing. Chinook, cohoe and chum salmon vertebral segments are large while those of the sockeye and humpback salmon are smaller.

Usually some of the skin adheres to the inside of the can. An excess of skin is not desirable. Humpback salmon have small scales. Chinook, cohoe and humpback salmon have spots on the skin on the superior part of the fish. Some fat beneath the skin is desirable.

Selection is based principally on soundness; sanitary handling; variety; kind and size of pieces; texture, color, flavor and odor of the meat; and the amount, color and richness of the oil. The purchase requirements should be consulted.

(b) Sardines. All sardines at time of receipt at a cannery should be inspected for soundness, quality and size. Unsound fish should be rejected. This includes especially those with undigested "red feed" and "blown bellies." Freshly caught, clean, small fish of uniform

size, are desirable. The preparation and packing should be sanitary also as required by purchasing authorities. Veterinary, sanitary supervision should be given all processes as cleaning, salting, steaming, frying.

(*Permission United States Bureau of Fisheries*)

Fig. 61. Lobster

oiling, packing, sealing, processing or other manipulation. Oils and sauces used should be of desirable grade, handled in a clean and sanitary manner and amounts as specified, used. Desirable tomato sauce is

prepared from ripe tomatoes of good consistency. Evisceration of fish should be thorough. The dressing, trimming, preparation and packing should be conducted as required. Whole fish should be packed evenly in neat rows, back or bellies up and in the number, specified. Cans should be full and weights should comply with requirements. Labeling should comply strictly with all existing pertinent food laws. Usually the name "Sardine," should be accompanied by the name of the state or country in which the fish are taken and packed, and a declaration of the nature of the preservative or flavoring ingredients used.

Selected samples should be of clean appearance, sound and comply with all requirements. Bones should be soft. The odor and flavor of the contents should be characteristic and pleasant. Defects include broken fish, those with an excess of viscera, blood, slime, "red feed," broken bellies, broken skin, too much salt, and mushy or mashed.

(c) Tuna. Tuna fish for canning should be sound, fresh, properly bled, dressed, cooked and otherwise properly prepared in compliance with all sanitary and other requirements. Bones, skin and dark meat are objectionable. Large pieces of the light meat are desirable. The light meat of the long finned tuna or albacore is white while that of the other tuna fish are more or less of a yellowish caste. The canned product should be firm and have a good, bright color and a pleasant flavor and odor.

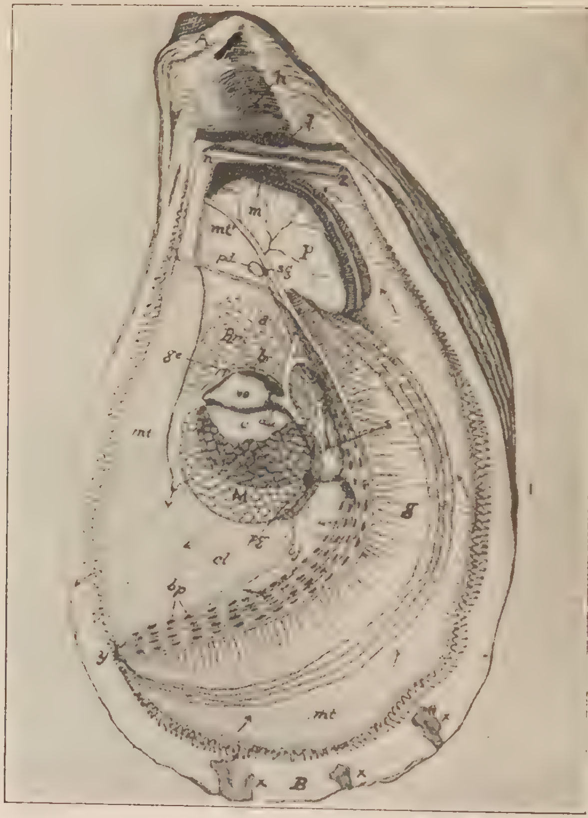
(d) Caviar. The label should state the species of fish from which the caviar is produced, also the presence of any approved coloring matter, if used. The roe of the sturgeon is a deep dark brown, of salmon a golden red, of German carp a pink or red, of white fish transparent and of paddle fish a greenish black. Mixed colored eggs are unattractive. Too much salt is objectionable. Caviar intended for the Army should meet all sanitary and other requirements.

(e) Other Fish. All other fish, canned for Army consumption should be characteristic, sound, and comply with all sanitary and purchase requirements.

(2) Canned Sea Foods. (a) Crab Meat. Crabs intended for Army consumption should be sound; live; freshly caught; properly preserved at low temperatures; thoroughly washed, cooked; freed from inedible and undesirable portions as the shell, "paper" shells between segments, viscera and discolored meat; and canned in compliance with all sanitary and purchase requirements.

Selected samples should be examined along the same general lines as described for canned meats. The odor should be pleasing,

characteristic of salt-fish and free from decomposition. The meat should be in small pieces, dry, and have a preponderance of white meat. The presence of brine, oil or other liquid is not desirable. It is desirable that



(*Permission United States Bureau of Fisheries*)

FIG. 62. ANATOMY OF THE OYSTER

(Oyster with right shell and mantle removed. *a* and *a*, origin of arteries from the ventricle; *au*, auricle of heart; *br*, vessel carrying blood from the gills to the auricle of the heart; *bj*, outline of organ of Bojanus, the so-called kidney; *bp*, pores from which the water issues into the branchial canals after passing through the gills; *cl*, cloaca; *d*, *pg* and *sg*, connective and two ganglia of the nervous system; *g*, gills; *gc*, cavity between the two mantle folds; *h*, hinge; *l*, ligament; *M*, adductor muscle; *m*, mouth; *mt*, mantle, the arrows show the direction of currents produced by the cilia; *p*, palps; *p'*, outer end of right pedal muscle; *s*, external opening of sexual and renal organs of right side; *v*, anus; *ve*, ventricle of heart.)

the meat consist of about five-sixths white, flake or body meat. After canning this meat becomes somewhat darker due to processing. Claw meat is darker than the white meat while the skin of the claws is quite black. Small yellow masses of orange yellow globules or eggs and granular fat, are not undesirable. A few, small blue spots due to a copper compound resulting from copper contained in the blood, usually are considered harmless. "Paper" shells in considerable quantity, viscera and gills, or the black discoloration of the meat by iron sulfide from the containers, are objectionable and sufficient to warrant rejection. The liver simulates fat in appearance while the other viscera is darker than the meat. The gills resemble a feather and are darker than the meat.

Japanese crab meat occurs in large pieces, and is uniformly white, bordered with a delicate pink shade.

Shells should be of good quality and properly washed, dried and packed in compliance with all sanitary and purchase requirements.

(b) Shrimp. It is desirable that shrimp intended for the Army be sound, freshly caught, live, preserved at a low temperature and properly washed cleaned, cooked, dried and canned, either wet or dry as specified, in compliance with all sanitary and purchase requirements. Shrimp should be freed from the head, viscera, shell and other objectionable parts. Soft or discolored shrimp and those with cracks or depressions on the outer surface, should be eliminated. Cans should be as full as practicable and in the wet pack should contain only sufficient fluid to fill the interstices and to cover the shrimp.

Selected samples should be examined along the same general lines as described for canned meats. Good, canned shrimp are characterized by a fresh, salt fish odor; a white color with distinct, delicate pink, joint stripes and a fine grained, firm meat, the pieces retaining their original form. The meat in the wet pack usually is not as firm as that in the dry pack. In the wet pack the liquor should be clear and sufficient to cover the product. In the dry pack the paper liners are usually discolored due to iron sulfide or other compound from the metal container. When the meat is discolored it should be rejected. There should be no liquor in the dry pack.

Shrimp which have been held too long before canning may have an ammoniacal or offensive odor, the meat is darker, the crosswise joint stripes are blurred and indistinct, the outer surface may show irregular longitudinal depressions or crevices and the meat may be stringy, ragged, slimy, soggy or with a tendency to fall apart. Such shrimp should be rejected. Borax and boric acid are considered adulterants.

The quantity of the contents of a can of shrimp should be declared on the basis of the "cut out" weight of drained meat. Usually it is considered that properly packed canned shrimp should contain not less than the following "cut out" weights:

SIZE OF CAN	DIAMETER	HEIGHT	"CUT-OUT" WEIGHT OF SHRIMP
Dry-Pack Shrimp			
	inches	*inches*	*ounces*
No. 1	$2\frac{11}{16}$	4	5
No. $1\frac{1}{2}$	Sanitary, $3\frac{7}{16}$ Hole and cap, $3\frac{3}{8}$	$3\frac{15}{16}$	$8\frac{1}{4}$
Wet-Pack Shrimp			
No. 1	$2\frac{11}{16}$	4	$5\frac{3}{4}$
No. $1\frac{1}{2}$	Sanitary, $3\frac{7}{16}$ Hole and cap, $3\frac{3}{8}$	$3\frac{15}{16}$	$9\frac{3}{4}$

In determining the "cut out" weight of a can, make a circular cut almost around the can, near the top. Invert the can and allow the liquor to drain through the opening one minute into a collander with openings not more than $\frac{3}{16}$ inch in diameter. Any solid particles escaping with the liquor should be returned to the can. The weight of the drained meat then should be ascertained.

Canned shrimp gradually lose flavor and discolor and darken with age, rendering them unsuitable for food. Usually canned shrimp is not held for more than one year.

(c) Other Sea Foods. All other sea-foods canned for Army consumption should be characteristic, sound and comply with all sanitary and purchase requirements. National and state, net weight and volume laws and other requirements should be consulted.

CHAPTER XVII

Products Inspection (continued)

K. FRESH MILK

1. General Considerations. Milk is the entire, lacteal secretion of a healthy, female mammal as a cow, goat, sheep, mare, etc. For the purpose of this text, unless otherwise specified, cow's milk is discussed. Reconstructed milk is discussed under Chapter XX, "Powdered Milk."

a. Colostrum. This is the mammary secretion of a cow just before, and continuing until five to eight days after, parturition. It is a viscous, thick, sticky, slimy fluid; yellowish-red to brown in color; of a salty flavor and unpleasant odor; rich in proteins, and cellular elements composed of colostrum corpuscles and leucocytes; and with a specific gravity of 1.030 to 1.090. It is acid in reaction to litmus, the acidity being 3 times as great as that of milk. For about four days after parturition it coagulates on boiling, and for four to twelve days after parturition it curdles when mixed with an equal volume of 68 per cent ethyl alcohol. Its average composition is specific gravity 1.042, water 75.07, casein 4.19, albumen 12.99, total proteins 17.18, fat 3.97, lactose 2.28, ash 1.53 and total solids 24.93.

b. Whole Milk. Milk is an opaque emulsion of a white to yellowish color with a sweet, aromatic odor and flavor. It contains fat globules, cellular elements, salts, enzymes, vitamins, antibodies, toxins and foreign matter. The specific gravity of milk at 15°C. is 1.027 to 1.034.

One Federal standard defined milk as follows:

> Milk is the fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and ten days after calving, and contains not less than eight and one half (8.5) per cent of solids not fat, and not less than three and one-quarter (3.25) per cent of milk fat.
>
> Blended milk is milk modified in its composition so as to have a definite and stated percentage of one or more of its constituents.

Limits of Variation in Composition of Milk from Various Mammals
(*Leach*)

	Specific gravity	Water	Casein	Albumin	Total protein	Fat	Lactose	Ash
Cow's milk:								
Minimum	1.0264	80.32	1.79	0.25	2.07	1.67	2.11	0.35
Maximum	1.0370	90.32	6.29	1.44	6.40	6.47	6.12	1.21
Mean	1.0315	87.27	3.02	0.53	3.55	3.64	4.88	0.71
Human milk:								
Minimum	1.027	81.09	0.18	0.32	0.69	1.43	3.88	0.12
Maximum	1.032	91.40	1.96	2.36	4.70	6.83	8.34	1.90
Mean		87.41	1.03	1.26	2.29	3.78	6.21	0.31
Goat's milk:								
Minimum	1.0280	82.02	2.44	0.79		3.10	3.26	0.36
Maximum	1.0360	90.16	3.94	2.01		7.55	5.77	1.06
Mean	1.0305	85.71	3.20	1.09	4.29	4.78	4.46	0.76
Ewe's milk:								
Minumim	1.0298	74.47	3.59	0.83		2.81	2.76	0.13
Maximum	1.0385	87.02	5.69	1.77		9.80	7.95	1.72
Mean	1.0341	80.82	4.97	1.55	6.52	6.86	4.91	0.89
Mare's milk:								
Mean	1.0347	90.78	1.24	0.75	1.99	1.21	5.67	0.35
Ass's milk:								
Mean	1.036	89.64	0.67	1.55	2.22	1.64	5.99	0.51

A yellow tint often seen in milk is due to lactochrome, sweetness is due to lactose and the aromatic qualities to volatile fatty acids. Off or "cowy" odors are due to the milk, while warm, absorbing and retaining stable, manure or other objectionable odors. The enzymes in milk include carbohydrate-splitting and proteolytic enzymes, oxydases and reductases. Normal, fresh milk is acid to phenolphthalein and rosolic acid, amphoteric to litmus and alkaline to dimethyl-orange. The milk from diseased cows often is more alkaline than normal milk.

Certain substances ingested by cows may appear in the milk or impart an abnormal flavor or odor to the milk. These include aloes, aspirin, arsenic, asafetida, atropine, bromides, chloroform, copper, ether, mercury compounds, potassium iodide, phenol, rhubarb, senna, sodium salicylate, turpentine, cabbage, ensilage, rape, turnips, certain weeds and others.

Cellular elements include epithelial cells from the mucosae of milk ducts, cisterns and teats, erythrocytes, leucocytes and bacteria. Normal milk may contain 50,000 to 1,000,000 histological cells per cubic

centimeter while in some cases of mastitis it varies from 500,000 to over 300,000,000 per cubic centimeter.

Only a small portion of the milk in the udder is sterile, as usually it becomes contaminated before leaving the smallest ducts. Certain bacteria are characteristic of udders, and sometimes disease-producing organisms or virus are eliminated in the milk.

Many sources of contamination exist between milking and the final consumption of milk; during milking, from the outside of the udder and coat of the animal, from the hands and clothing of the milkers, from insanitary milking machines or from the dust of the stable or milking room; from flies, from machinery, bottles, or other utensils; during transportation or while in the hands of milk dealers or consumers.

These bacteria increase at an enormous rate even at 15°C. so that milk as delivered to the consumer may contain from 300,000 to over 20,000,000 bacteria per cubic centimeter. The great majority of such organisms are harmless saprophytes as lactobacilli, streptococcus lacticus, certain B. coli, chromogenic and spore bearing bacteria, torula, yeasts, moulds and others capable of producing changes in the milk, such as an increase in lactic acid formation with souring; gas formation; fruitlike odors; bitter, soapy or other abnormal flavors; a slimy, ropy or stringy condition; sweet curdling from rennet forming bacteria; and proteolytic and other changes.

Not infrequently from infected animals, flies, human carriers, contaminated bottles and utensils or by other means, pathogenic organisms gain access. Epidemics and cases of, sore throat, tuberculosis, typhoid, paratyphoid, diphtheria, scarlet fever, Asiatic cholera, anthrax, rabies, cowpox, foot-and-mouth disease, milk sickness, cholera infantum, Malta fever (goats) and other diseases have been traced to infected milk supplies. It is stated that the milk from cows eating certain kinds of weeds may be conducive of hay fever when consumed by a susceptible individual.

Fermented milks as kefir, kumiss, yoghurt and Bulgarian milk may be produced from proper cultures.

c. Skim Milk and Cream. Whole milk may be separated out on standing or upon contrifuging, into skim milk and cream.

One Federal standard defined skim milk, and cream as follows:

Skim milk is milk from which a part or all of the cream has been removed and contains not less than nine and one-quarter (9.25) per cent of milk solids.

Cream is that portion of milk, rich in milk fat, which rises to the surface of milk on standing, or is separated from it by centrifugal force, is fresh and clean and contains not less than eighteen (18) per cent of milk fat.

Fresh whole milk may be placed into shallow pans and allowed to stand thirty-six hours at 60°F. or into deeper containers and allowed to stand twenty-four hours at 40 to 50°F. in order to effect a gravity separation of the cream and skim milk. Upon standing (creaming) most of the milk fat accumulates on the surface in a yellow layer. This may be skimmed off as cream while the residue is skim milk. In gravity creaming, a considerable amount of bacteria and debris are deposited on the bottom of the receptable. The skim milk obtained by this method of separation contains 0.2 to 0.5 per cent of fat. Heating or agitation of whole milk retards gravity creaming. A dilution method also is used to effect gravity cream separation.

Fresh, whole milk may be centrifuged to separate the skim milk from the cream. In this instance many bacteria, body cells and dirt also are removed from the products. Centrifuged skim milk contains about 0.1 to 0.2 per cent of fat. Market cream averages 18 to 25 per cent of fat but may contain 50 per cent or more.

Whipping Cream. Fresh cream, cream of low butter fat content, warm, heated and pasteurized creams, due to low viscosity do not whip well. To increase the viscosity fresh cream may be held twelve to twenty-four hours at 35 to 45°F. for the development of a small amount of acid. The acid effects a gelatinous consistency in the albumin and casein. Instead of holding fresh cream, $\frac{1}{10}$ per cent of commercial lactic acid, or 0.75 per cent to 1 per cent of calcium sucrate may be added. Cream containing any added substance should be so labeled. Calcium sucrate or "Viscogen" is prepared by adding lime water to a solution of granulated sugar, and mixing. An excess of sucrate of lime in milk produces a soapy flavor.

Maryland Bulletin 136 states as follows:

1. There was no difference in the whipping qualities of gravity and separator cream. When any difference is experienced it is due to other factors and not to the method of getting the cream from milk.

2. Cream for whipping purposes should contain at least 20 per cent butterfat. The results were obtained with cream containing from 25 per cent to 40 per cent butter fat.

3. For best results cream should be held at as low a temperature as possible (35° to 45° F.) for at least two hours before whipping, and should be whipped in a cool room.

4. For good results cream should be from twelve to twenty-four hours old. This gives an opportunity for the development of a small amount of acid in the cream. The acid effected a gelatinous consistency in the casein and albumin and thus facilitated the incorporation of air in whipping. When it is desired to whip fresh cream, $\frac{3}{10}$ per cent commercial lactic acid may be added to take the place of

the acid which would develop by setting the cream from twelve to twenty-four hours.

5. Pasteurized cream may be whipped as easily as unpasteurized cream if it is thoroughly cooled and held at 35° to 45°F. for at least two hours before whipping.

6. For good results cream should whip in from thirty to sixty seconds. When a longer time is required there is danger of some of the butterfat separating or churning.

7. The addition of one-tenth per cent of commercial lactic acid to cream facilitated its whipping and made it possible to whip cream which was fresher, which contained less butterfat and which was warmer than is advisable for the best results.

8. The use of viscogen facilitated the whipping of cream to a greater extent than any other ingredient with the exception of lactic acid. It proved less effective than the latter and also less effective than a low temperature. The addition of viscogen caused cream to remain sweet from twelve to twenty-four hours longer than it otherwise would.

9. The use of powdered sugar, powdered milk, salt, caramel, gelatine, junket, and cornstarch, each facilitated the whipping of cream to a small degree, and each to practically the same extent. None of them proved as effective as a low temperature and the development or addition of lactic acid. The addition of an excess of gelatine above 10 per cent, or of cornstarch above 20 per cent caused a lumpy cream when whipped.

10. The use of egg albumen with cream when whipped separately and mixed, produced a lighter foam, but had no effect upon the time required to whip. When mixed before the egg albumen was whipped, at temperatures above 40°F., the whipping was retarded.

11. The use of vanilla extract used in ordinary quantities had no effect upon the whipping qualities of cream.

12. The charging of cream with carbonic acid gas without pressure had no effect on its whipping qualities but caused it to remain sweet from twelve to twenty-four hours longer.

13. The use of cream from cows near the end of their lactation period whipped with slightly more difficulty than did cream from fresh cows.

14. Whipped cream will not keep sweet as long as unwhipped cream.

15. When any additions are made to cream to facilitate whipping it should be so labeled as to not deceive the purchaser.

AVERAGE COMPOSITION OF SKIM MILK AND CREAM

(*Konig*)

	SKIM MILK	CREAM
Water	90.66	65.51
Casein and Albumin	3.11	3.61
Fat	0.74	26.75
Sugar	4.75	3.52
Ash	0.74	0.61
Total Solids	9.34	34.49

2. Grades of milk. a. Certified Milk. Certified milk includes clean, raw milk, skim milk or cream produced in compliance with the requirements of the American Association of Medical Milk Commissions.

Methods and Standards for the Production and Distribution of Certified Milk

(Adopted by the American Association of Medical Milk Commissions May 1, 1912)

HYGIENE OF THE DAIRY

Under the Supervision and Control of the Veterinarian

1. *Pastures or Paddocks.* Pastures or paddocks to which the cows have access shall be free from marshes or stagnant pools, crossed by no stream which might become dangerously contaminated, at sufficient distances from offensive conditions to suffer no bad effects from them, and shall be free from plants which effect the milk deleteriously.

2. *Surroundings of Buildings.* The surroundings of all buildings shall be kept clean and free from accumulations of dirt, rubbish, decayed vegetable or animal matter or animal waste, and the stable yard shall be well drained.

3. *Location of Buildings.* Buildings in which certified milk is produced and handled shall be so located as to insure proper shelter and good drainage, and at sufficient distance from other buildings, dusty roads, cultivated and dusty fields, and all other possible sources of contamination; provided, in the case of unavoidable proximity to dusty roads or fields, the exposed side shall be screened with cheesecloth.

4. *Construction of Stables.* The stables shall be constructed so as to facilitate the prompt and easy removal of waste products. The floors and platforms shall be made of cement or other non-absorbent material and the gutters of cement only. The floors shall be properly graded and drained, and the manure gutters shall be form 6 to 8 inches deep and so placed in relation to the platform that all manure will drop into them.

5. The inside surface of the walls and all interior construction shall be smooth, with tight joints, and shall be capable of shedding water. The ceiling shall be of smooth material and dust-tight. All horizontal and slanting surfaces which might harbor dust shall be avoided.

6. *Drinking and Feed Troughs.* Drinking troughs or basins shall be drained and cleaned each day, and feed troughs and mixing floors shall be kept in a clean and sanitary condition.

7. *Stanchions.*—Stanchions, when used, shall be constructed of iron pipes or hard wood, and throat latches shall be provided to prevent the cows from lying down between the time of cleaning and the time of milking.

8. *Ventilation.* The cow stables shall be provided with adequate ventilation either by means of some approved artificial device, or by the substitution of cheesecloth for glass in the windows, each cow to be provided with a minmum of 600 cubic feet of air space.

9. *Windows.* A sufficient number of windows shall be installed and so distributed as to provide satisfactory light and a maximum of sunshine, 2 feet square

of window area to each 600 cubic feet of air space to represent the minimum. The coverings of such windows shall be kept free from dust and dirt.

10. *Exclusion of Flies, etc.* All necessary measures should be taken to prevent the entrance of flies and other insects and rats and other vermin into all the buildings.

11. *Exclusion of Animals from the Herd.* No horses, hogs, dogs, or other animals or fowls shall be allowed to come in contact with the certified herd, either in the stables or elsewhere.

12. *Bedding.* No dusty or moldy hay or straw, bedding from horse stalls, or other unclean materials shall be used for bedding the cows. Only bedding which is clean, dry, and absorbent may be used, preferably shavings or straw.

13. *Cleaning Stable and Disposal of Manure.* Soiled bedding and manure shall be removed at least twice daily, and the floors shall be swept and kept free from refuse. Such cleaning shall be done at least one hour before the milking time. Manure, when removed, shall be drawn to the field or temporarily stored in containers so screened as to exclude flies. Manure shall not be even temporarily stored within 300 feet of the barn or dairy building.

14. *Cleaning of Cows.* Each cow in the herd shall be groomed daily, and no manure, mud, or filth shall be allowed to remain upon her during milking; for cleaning, a vacuum apparatus is recommended.

15. *Clipping.* Long hairs shall be clipped from the udder and flanks of the cow and from the tail above the brush. The hair on the tail shall be cut so that the brush may be well above the ground.

16. *Cleaning of Udders.* The udders and teats of the cow shall be cleaned before milking; they shall be washed with a cloth and water, and dry wiped with another clean sterilized cloth—a separate cloth for drying each cow.

17. *Feeding.* All food-stuffs shall be kept in an apartment separate from and not directly communicating with the cow barn. They shall be brought into the barn only immediately before the feeding hour, which shall follow the milking.

18. Only those foods shall be used which consist of fresh, palatable, or nutritious materials, such as will not injure the health of the cows or unfavorably affect the taste or character of the milk. Any dirty or moldy food or food in a state of decomposition or putrefaction shall not be given.

19. A well-balanced ration shall be used, and all changes of food shall be made slowly. The first feedings of grass, alfalfa, ensilage, green corn, or other green feeds shall be given in small rations and increased gradually to full ration.

20. *Exercise.* All dairy cows shall be turned out for exercise at least two hours in each twenty-four in suitable weather. Exercise yards shall be kept free from manure and other filth.

21. *Washing of Hands.* Conveniently located facilities shall be provided for the milkers to wash in before and during milking.

22. The hands of the milkers shall be thoroughly washed with soap, water, and brush and carefully dried on a clean towel immediately before milking. The hands of the milkers shall be rinsed with clean water and carefully dried before milking each cow. The practice of moistening the hands with milk is forbidden.

23. *Milking Clothes.* Clean overalls, jumper, and cap shall be worn during milking. They shall be washed or sterilized each day and used for no other pur-

pose, and when not in use they shall be kept in a clean place, protected from dust and dirt.

24. *Things to be Avoided by Milkers.* While engaged about the dairy or in handling the milk employees shall not use tobacco nor intoxicating liquors. They shall keep their fingers away from their nose and mouth, and no milker shall permit his hands, fingers, lips, or tongue to come in contact with milk intended for sale.

25. During milking the milkers shall be careful not to touch anything but the clean top of the milking stool, the milk pail, and the cow's teats.

26. Milkers are forbidden to spit upon the walls or floors of stables, or upon the walls or floors of milk houses, or into the water used for cooling the milk or washing the utensils.

27. *Fore-milk.* The first streams from each teat shall be rejected, as this fore-milk contains large numbers of bacteria. Such milk shall be collected into a separate vessel and not milked on to the floors or into the gutters. The milking shall be done rapidly and quietly, and the cows shall be treated kindly.

28. *Milk and Calving Period.* Milk from all cows shall be excluded for a period of forty-five days before and seven days after parturition.

29. *Bloody and Stringy Milk.* If milk from any cow is bloody and stringy or of unnatural appearance, the milk from that cow shall be rejected and the cow isolated from the herd until the cause of such abnormal appearance has been determined and removed, special attention being given in the meantime to the feeding or to possible injuries. If dirt gets into the pail, the milk shall be discarded and the pail washed before it is used.

30. *Make-up of Herd.* No cows except those receiving the same supervision and care as the certified herd shall be kept in the same barn or brought in contact with them.

31. *Employees Other than Milkers.* The requirements for milkers, relative to garments and cleaning of hands, shall apply to all other persons handling the milk, and children unattended by adults shall not be allowed in the dairy nor in the stable during milking.

32. *Straining and Strainers.* Promptly after the milk is drawn it shall be removed from the stable to a clean room and then emptied from the milk pail to the can, being strained through strainers made of a double layer of finely meshed cheesecloth or absorbent cotton thoroughly sterilized. Several strainers shall be provided for each milking in order that they may be frequently changed.

33. *Dairy Building.* A dairy building shall be provided which shall be located at a distance from the stable and dwelling prescribed by the local commission, and there shall be no hogpen, privy, or manure pile at a higher level or within 300 feet of it.

34. The dairy building shall be kept clean and shall not be used for purposes other than the handling and storing of milk and milk utensils. It shall be provided with light and ventilation, and the floors shall be graded and water-tight.

35. The dairy building shall be well lighted and screened and drained through well-trapped pipes. No animals shall be allowed therein. No part of the dairy building shall be used for dwelling or lodging purposes, and the bottling room shall be used for no other purpose than to provide a place for clean milk utensils and

for handling the milk. During bottling this room shall be entered only by persons employed therein. The bottling room shall be kept scrupulously clean and free from odors.

36. *Temperature of Milk.* Proper cooling to reduce the temperature to 45°F. shall be used, and aërators shall be so situated that they can be protected from flies, dust, and odors. The milk shall be cooled immediately after being milked, and maintained at a temperature between 35° and 45°F. until delivered to the consumer.

37. *Sealing of Bottles.* Milk, after being cooled and bottled, shall be immediately sealed in a manner satisfactory to the commission, but such seal shall include a sterile hood which completely covers the lip of the bottle.

38. *Cleaning and Sterilizing of Bottles.* The dairy buildings shall be provided with approved apparatus for the cleansing and sterilizing of all bottles and utensils used in milk production. All bottles and utensils shall be thoroughly cleaned by hot water and sal soda, or equally pure agent, rinsed until the cleaning water is thoroughly removed, then exposed to live steam or boiling water at least twenty minutes, and then kept inverted until used, in a place free from dust and other contaminating materials.

39. *Utensils.* All utensils shall be so constructed as to be easily cleaned. The milk pail should preferably have an elliptical opening 5 by 7 inches in diameter. The cover of this pail should be so convex as to make the entire interior of the pail visible and accessible for cleaning. The pail shall be made of heavy seamless tin, and with seams which are flushed and made smooth by solder. Wooden pails, galvanized-iron pails, or pails made of rough, porous materials are forbidden. All utensils used in milking shall be kept in good repair.

40. *Water-supply.* The entire water-supply shall be absolutely free from contamination, and shall be sufficient for all dairy purposes. It shall be protected against flood or surface drainage, and shall be conveniently situated in relation to the milk house.

41. *Privies, etc., in Relation to Water-supply.* Privies, pigpens, manure piles, and all other possible sources of contamination shall be so situated on the farm as to render impossible the contamination of the water-supply, and shall be so protected by use of screens and other measures as to prevent their becoming breeding grounds for flies.

42. *Toilet Rooms.* Toilet facilities for the milkers shall be provided and located outside of the stable or milk house. These toilets shall be properly screened, shall be kept clean, and shall be accessible to wash basins, water, nail-brush, soap and towels, and the milkers shall be required to wash and dry their hands immediately after leaving the toilet room.

TRANSPORTATION

43. In transit the milk packages shall be kept free from dust and dirt. The wagon, trays, and crates shall be kept scrupulously clean. No bottles shall be collected from houses in which communicable diseases prevail, unless a separate wagon is used and under conditions prescribed by the department of health and the medical milk commission.

44. All certified milk shall reach the consumer within thirty hours after milking.

VETERINARY SUPERVISION OF THE HERD

45. *Tuberculin Test.* The herd shall be free from tuberculosis, as shown by the proper application of the tuberculin test. The test shall be applied in accordance with the rules and regulations of the United States Government, and all reactors shall be removed immediately from the farm.

46. No new animals shall be admitted to the herd without first having passed a satisfactory tuberculin test, made in accordance with the rules and regulations mentioned; the tuberculin to be obtained and applied only by the official veterinarian of the commission.

47. Immediately following the application of the tuberculin test to a herd for the purpose of eliminating tuberculous cattle, the cow stable and exercising yards shall be disinfected by the veterinary inspector in accordance with the rules and regulations of the United States Government.

48. A second tuberculin test shall follow each primary test after an interval of six months, and shall be applied in accordance with the rules and regulations mentioned. Thereafter, tuberculin tests shall be reapplied annually, but it is recommended that the retests be applied semi-annually.

49. *Identification of Cows.* Each dairy cow in each of the certified herds shall be labeled or tagged with a number or mark which will permanently identify her.

50. *Herd-book Record.* Each cow in the herd shall be registered in a herd book, which register shall be accurately kept so that her entrance and departure from the herd and her tuberculin testing can be identified.

51. A copy of this herd-book record shall be kept in the hands of the veterinarian of the medical milk commission under which the dairy farm is operating, and the veterinarian shall be made responsible for the accuracy of this record.

52. *Dates of Tuberculin Tests.* The dates of the annual tuberculin tests shall be definitely arranged by the medical milk commission, and all of the results of such tests shall be recorded by the veterinarian and regularly reported to the secretary of the medical milk commission issuing the certificate.

53. The results of all tuberculin tests shall be kept on file by each medical milk commission, and a copy of all such tests shall be made available to the American Association of Medical Milk Commissions for statistical purposes.

54. The proper designated officers of the American Association of Medical Milk Commissions should receive copies of reports of all of the annual, semi-annual, and other official tuberculin tests which are made and keep copies of the same on file and compile them annually for the use of the association.

55. *Disposition of Cows Sick with Diseases Other than Tuberculosis.* Cows having rheumatism, leukorrhea, inflammation of the uterus, severe diarrhea, or disease of the udder, or cows that from any other cause may be a menace to the herd shall be removed from the herd and placed in a building separate from that which may be used for the isolation of cows with tuberculosis, unless such building has been properly disinfected since it was last used for this purpose. The milk from such cows shall not be used nor shall the cows be restored to the herd until permission has been given by the veterinary inspector after a careful physical examination.

56. *Notification of Veterinary Inspector.* In the event of the occurrence of any of the diseases just described between the visits of the veterinary inspector, or if at any time a number of cows become sick at one time in such a way as to suggest

the outbreak of a contagious disease or poisoning, it shall be the duty of the dairyman to withdraw such sickened cattle from the herd, to destroy their milk, and to notify the veterinary inspector by telegraph or telephone immediately.

57. *Emaciated Cows.* Cows that are emaciated from chronic diseases or from any cause that in the opinion of the veterinary inspector may endanger the quality of the milk, shall be removed from the herd.

BACTERIOLOGIC STANDARDS

58. *Bacterial Counts.* Certified milk shall contain less than 10,000 bacteria per cubic centimeter when delivered. In case a count exceeding 10,000 bacteria per cubic centimeter is found, daily counts shall be made, and if normal counts are not restored within ten days the certificate shall be suspended.

59. Bacterial counts shall be made at least once a week.

60. *Collection of Samples.* The samples to be examined shall be obtained from milk as offered for sale and shall be taken by a representative of the milk commission. The samples shall be received in the original packages, in properly iced containers, and they shall be so kept until examined, so as to limit as far as possible changes in their bacterial content.

61. For the purpose of ascertaining the temperature, a separate original package shall be used, and the temperature taken at the time of collecting the sample, using for the purpose a standardized thermometer graduated in the centigrade scale.

62. *Interval Between Milking and Plating.* The examinations shall be made as soon after collection of the samples as possible, and in no case shall the interval between milking and plating the samples be longer than forty hours.

63. *Plating.* The packages shall be opened with aseptic precautions after the milk has been thoroughly mixed by vigorously reversing and shaking the container twenty-five times.

64. Two plates at least shall be made for each sample of milk, and there shall also be made a control of each lot of medium and apparatus used at each testing. The plates shall be grown at 37°C. for forty-eight hours.

65. In making the plates there shall be used agar-agar media containing 1.5 per cent agar and giving a reaction of 1.0 to phenolphthalein.

The following is the method recommended by a committee of the American Public Health Association for the making of the media, modified, however, as to the agar content and reaction to conform to the requirements specified in Section 65:

1. Boil 15 grams of thread agar in 500 cc. of water for half an hour and make up weight to 500 grams, or digest for ten minutes in the autoclave at 110°C. Let this cool to about 60°C.
2. Infuse 500 grams finely chopped lean beef for twenty-four hours with its own weight of distilled water in the refrigerator.
3. Make up any loss by evaporation.
4. Strain infusion through cotton flannel, using pressure.
5. Weigh filtered infusion.
6. Add Witte's peptone, 2 per cent.
7. Warm on water-bath, stirring until peptone is dissolved and not allowing temperature to rise above 60°C.

8. To the 500 grams of meat infusion (with peptone) add 500 grams of the 2 per cent agar, keeping the temperature below 60°C.
9. Heat over boiling water (or steam) bath thirty minutes.
10. Restore weight lost by evaporation.
11. Titrate after boiling one minute to expel carbonic acid.
12. Adjust reaction to final point desired +1 by adding normal sodium hydrate.
13. Boil two minutes over free flame, constantly stirring.
14. Restore weight lost by evaporation.
15. Filter through absorbent cotton or coarse filter paper, passing the filtrate through the filter repeatedly until clear.
16. Titrate and record the final reaction.
17. Tube (10 cc. to a tube) and sterilize in autoclave one hour at 15 pounds pressure or in the streaming steam for twenty minutes on three successive days.

66. Samples of milk for plating shall be diluted in the proportion of 1 part of milk to 99 parts of sterile water; shake twenty-five times and plate 1 cc. of the dilution.

The committee on bacterial milk analyses of the American Public Health Association in Part IV of its report presented details with respect to plating apparatus and technic in part as follows:

Plating Apparatus. For plating it is best to have a water-bath in which to melt the media and a water-jacketed water-bath for keeping it at the required temperature; a wire rack which should fit both the water-baths for holding the media tubes; a thermometer for recording the temperature of the water in the water-jacketed bath, sterile 1 cc. pipets, sterile Petri dishes, and sterile dilution water in measured quantities.

Dilutions. Ordinary potable water, sterilized, may be used for dilutions. Occasionally spore forms are found in such water which resist ordinary autoclave sterilization; in such cases distilled water may be used or the autoclave pressure increased. With dilution water in 8-ounce bottles calibrated for 99 cc. . . . all the necesary dilutions may be made.

Short, wide-mouthed "blakes" or wide-mouthed French square bottles are more easily handled and more economical of space than other forms of bottles or flasks.

Eight-ounce bottles are the best, as the required amount of dilution water only about half fills them, leaving room for shaking. Long-fiber non-absorbent cotton should be used for plugs. It is well to use care in selecting cotton for this purpose, to avoid short-fiber or dusty cotton, which gives a cloud of lint-like particles on shaking. Bottles . . . should be filled a little over the 99 cc. . . . to allow for loss during sterilization.

Pipets. Straight sides 1 cc. pipets are more easily handled than those with bulbs; they may be made from ordinary $\frac{3}{16}$-inch glass tubing and should be about 10 inches in length.

Plating Technic. The agar after melting should be kept in the water-jacketed water-bath between 40° and 45°C. for at least fifteen minutes before using to make sure that the agar itself has reached the temperature of the surrounding water. If used too warm the heat may destroy some of the bacteria or retard their growth.

Shake the milk sample twenty-five times, then with a sterile pipet transfer 1 cc. to the first dilution water and rinse the pipet by drawing dilution water to the mark and expelling; this gives a dilution 1 to 100.

. . . Then with a sterile pipet transfer 1 cc. to the Petri dish, using care to raise the cover only as far as necessary to insert the end of the pipet.

Take the tube of agar from the water-bath, wipe the water from outside the tube with a piece of cloth, remove the plug, pass the mouth of the tube through a flame, and pour the agar into the plate, using the same care as before to avoid exposure of the plate contents to the air.

Carefully and thoroughly mix the agar and diluted milk in the Petri dish by a rotary motion, avoiding the formation of air bubbles or slopping the agar, and after allowing the agar to harden for at least fifteen minutes at room temperature, place the dish bottom down in the incubator.

Plating should always be done in a place free from dust or currents of air.

In order that colonies may have sufficient food for proper development 10 cc. of agar shall be used for each plate.

67. *Determination of Taste and Odor of Milk.* After the plates have been prepared and placed in the incubator, the taste and odor of the milk shall be determined after warming the milk to 100°F.

68. *Counts.* The total number of colonies on each plate should be counted, and the results expressed in multiples of the dilution factor. Colonies too small to be seen with the naked eye or with slight magnification shall not be considered in the count.

69. *Records of Bacteriologic Tests.* The results of all bacterial tests shall be kept on file by the secretary of each commission, copies of which should be made available annually for the use of the American Association of Medical Milk Commissions.

CHEMICAL STANDARDS AND METHODS

The methods that must be followed in carrying out the chemical investigations essential to the protection of certified milk are so complicated that in order to keep the fees of the chemist at a reasonable figure, there must be eliminated from the examination those procedures which, while they might be helpful and interesting, are in no sense necessary.

For this reason the determination of the water, the total solids, and the milk-sugar is not required as a part of the routine examination.

70. The chemical analyses shall be made by a competent chemist designated by the medical milk commission.

71. *Method of Obtaining Samples.* The samples to be examined by the chemist shall have been examined previously by the bacteriologist designated by the medical milk commission as to temperature, odor, taste, and bacterial content.

72. *Fat Standards.* The fat standard for certified milk shall be 4 per cent, with a permissible range of variation of from 3.5 to 4.5 per cent.

73. The fat standard for certified cream shall be not less than 18 per cent.

74. If it is desired to sell higher fat-percentage milks or creams as certified milks or creams, the range of variation for such milks shall be 0.5 per cent on either side of the advertised percentage and the range of variations for such creams shall be 2 per cent on either side of the advertised percentage.

75. The fat content of certified milks and creams shall be determined at least once each month.

76. The methods recommended for this purpose are the Babcock (*a*), the Leffmann-Beam (*b*), and the Gerber (*c*).

(*a*) *Babcock Test.* The Babcock test is based on the fact that strong sulphuric acid will dissolve the non-fatty solid constituents of milk, and thus enable the fat to separate on standing. It can be conducted by any of the Babcock outfits which are purchasable in the market.

"The test is made by placing in the special test bottle 18 grams (17.6 cc.) of milk. To this is added, from a pipet, buret, or measuring bottle, 17.5 cc. commercial sulphuric acid of a specific gravity of 1.82 to 1.83. The contents of the bottle are carefully and thoroughly mixed by a rotary motion. The mixture becomes brown and heat is generated. The test bottle is now placed in a properly balanced centrifuge and whirled for five minutes at a speed of from 800 to 1200 revolutions per minute. Hot water is then added to fill the bottle to the lower part of the neck, after which it is again whirled for two minutes. Now, enough hot water is added to float the column of fat into the graduated portion of the neck of the bottle, and the whirling is repeated for a minute. The amount of fat is read while the neck of the bottle is still hot. The reading is from the upper limits of the meniscus. A pair of calipers is of assistance in measuring the column of fat." (Jensen's Milk Hygiene, Leonard Pearson's translation.)

(*b*) *Leffmann-Beam Test.* The distinctive feature is the use of fusel oil, the effect of which is to produce a greater difference in surface tension between the fat and the liquid in which it is suspended, and thus promote its readier separation. This effect has been found to be heightened by the presence of a small amount of hydrochloric acid.

The test bottles have a capacity of about 30 cc. and are provided with a graduated neck, each division of which represents 9.1 per cent by weight of butter-fat.

Fifteen centimeters of the milk are measured into the bottle, 3 cc. of a mixture of equal parts of amyl alcohol and strong hydrochloric acid added and mixed. Then 9 cc. of concentrated sulphuric acid is added in portions of about 1 cc.; after each addition the liquids are mixed by giving the bottle a gyratory motion. If the fluid has not lost all of its milky color by this treatment, a little more concentrated acid must be added. The neck of the bottle is now immediately filled at about the zero point with 1 part sulphuric acid and 2 parts water, well mixed just before using. Both the liquid in the bottle and the diluted acid must be hot. The bottle is then placed at once in the centrifugal machine; after rotation from one to two minutes, the fat will collect in the neck of the bottle and the percentage may be read off.

(*c*) *Gerber's Test.* This test is applied as follows: The test bottles are put into the stand with the mouths uppermost; then, with the pipet designed for the purpose, or with an automatic measurer, 10 cc. of sulphuric acid are filled into the test bottle, care being taken not to allow any to come in contact with the neck. The few drops remaining in the tip of the pipet should not be blown out. Then 11 cc. of milk are measured with the proper pipet and allowed to flow slowly on to the acid, so that the two liquids mix as little as possible. Finally, the amyl alcohol is added. (It is important to use the reagents in the proper order, which is —sulphuric acid, milk, amyl alcohol. If the sulphuric acid is followed by amyl

alcohol and the milk last, then the result is sometimes incorrect.) A rubber stopper, which must not be damaged, is then fitted into the mouth of the test bottle, and the contents are well shaken, the thumb being kept on the stopper to prevent it coming out. As a considerable amount of heat is generated by the action of the sulphuric acid on the milk, the test bottle should be wrapped in a cloth.

The shaking of the sample must be done thoroughly and quickly, and the test bottle inverted several times, so that the liquid in the neck becomes thoroughly mixed. By pressing in the rubber stopper the height of the liquid can be brought to about the zero point on the scale.

If only a few samples have to be analyzed and the room is warm, the test bottles can be put into the centrifuge without any preliminary heating, otherwise the test bottles must be warmed for a few minutes (not longer) in the water-bath at a temperature of 60° to 65°C. When the temperature rises higher than this, say above 70°C., the rubber stopper is liable to be blown out of the test bottle. After the test bottles have been heated they are arranged symmetrically in the centrifuge and whirled for three to four minutes at a speed of about 1000 revolutions per minute. When the centrifuge has a heating arrangement attached to it, the preliminary warming is not, of course, necessary. When the test bottles are taken out of the centrifuge, they are again placed in the water-bath at a temperature of 60° to 65°C., and left there for several minutes before being read; where the centrifuge is heated, the tubes can be read off as taken from the centrifuge.

By carefully screwing in the rubber stopper, or even by pressing it, the lower limit of the fat column is brought on to one of the main divisions of the scale, and then, by holding the test bottle against the light, the height of the column of fat can be accurately ascertained. The lowest point of the meniscus is taken as the level when reading the upper surface of the fat in a sample of whole milk, and the middle of the meniscus for separated milk.

If the column of fat is not clear and sharply defined, the sample must be again whirled in the centrifuge.

Each division on the scale is equivalent to 0.1 per cent, so it is very easy to read to 0.05 per cent or, with a lens, to 0.025 per cent. If the number which is read off is multiplied by 0.1, then the percentage quantity of fat in the milk is obtained, *e.g.*, if the number on the scale was 36.5, then the percentage of fat is 3.65. (Milk and Dairy Products, Barthel; translated by Goodwin, p. 71.)

77. Before condemning samples of milk which have fallen outside the limits allowed, the chemist shall have determined, by control ether extractions, that his apparatus and his technic are reliable.

78. *Protein Standard.* The protein standard for certified milk shall be 3.50 per cent, with a permissible range of variation of from 3 to 4 per cent.

79. The protein standard for certified cream shall correspond to the protein standard for certified milk.

80. The protein content shall be determined only when any special consideration seems to the medical milk commission to make it desirable.

81. It shall be determined by the Kjeldahl method, using the Gunning or some other reliable modification, and employing the factor 6.25 in reckoning the protein from the nitrogen.

Kjeldahl Method. Five cubic centimeters of milk are measured carefully into a flat-bottom 800 cc. Jena flask, 20 cc. of concentrated sulphuric acid (C. P.; sp. gr., 1.84) are added, and 0.7 gram of mercuric oxid (or its equivalent in metallic mercury); the mixture is then heated over direct flame until it is straw-colored or perfectly white; a few crystals of potassium permanganate are now added till the color of the liquid remains green. All the nitrogen in the milk has then been converted into the form of ammonium sulphate. After cooling, 200 cc. of ammonia-free distilled water are added, 20 cc. of a solution of potassium sulphid (containing 40 grams sulphid per liter), and a fraction of a gram of powdered zinc. A quantity of semi-normal HCl solution more than sufficient to neutralize the ammonia obtained in the oxidation of the milk is now carefully measured out from a delicate buret (divided into $\frac{1}{20}$ cc.) into an Erlenmeyer flask and the flask connected with a distillation apparatus. At the other end the Jena flask containing the watery solution of the ammonium sulphate is connected, after adding 50 cc. of a concentrated soda solution (1 pound "pure potash" dissolved in 500 cc. of distilled water and allowed to settle); the contents of the Jena flask are now heated to boiling, and the distillation is continued for forty minutes to an hour, until all ammonia has been distilled over.

The excess of acid in the Erlenmeyer receiving flask is then accurately titrated back by means of a tenth-normal standard ammonia solution, using a cochineal solution as an indicator. From the amount of acid used the per cent of nitrogen is obtained; and from it the per cent of casein and albumen in the milk by multiplying by 6.25. The amount of nitrogen contained in the chemicals used is determined by blank experiments and deducted from the nitrogen obtained as described. (Farrington and Woll, Testing Milk and Its Products, p. 221.)

82. *Coloring-matter and Preservatives.* All certified milks and creams shall be free from adulteration, and coloring-matter and preservatives shall not be added thereto.

83. Tests for the detection of added coloring-matter shall be applied whenever the color of the milk or cream is such as to arouse suspicion.

Test for Coloring-matter. The presence of foreign coloring-matter in milk is easily shown by shaking 10 cc. of the milk with an equal quantity of ether; on standing, a clear ether solution will rise to the surface; if artificial coloring-matter has been added to the milk, the solution will be yellow colored, the intensity of the color indicating the quantity added; natural fresh milk will give a colorless ether solution. (Testing Milk and Its Products, Farrington and Woll, p. 244.)

84. Tests for the detection of formaldehyd, borax, and boric acid shall be applied at least once each month. Occasionally application of tests for the detection of salicylic acid, benzoic acid, and the benzoates is also recommended.

Test for the Detection of Formaldehyd. Five cubic centimeters of milk is measured into a white porcelain dish, and a similar quantity of water added; 10 cc. of HCl, containing a trace of Fe_2Cl_6, is added, and the mixture is heated very slowly. If formaldehyd is present, a violet color will be formed. (Testing Milk and Its Products, Farrington and Woll, p. 249.)

Test for Boric Acid (Borax, Borates, Preservaline, etc.). One hundred cubic centimeters of milk are made alkaline with a soda or potash solution, and then evaporated to dryness and incinerated. The ash is dissolved in water, to which a little hydrochloric acid has been added, and the solution filtered. A strip of tur-

meric paper moistened with the filtrate will be colored reddish brown when dried at 100°C. on a watch-glass, if boric acid is present.

If a little alcohol is poured over the ash to which concentrated sulphuric acid has been added, and fire is set to the alcohol, after a little while this will burn with a yellowish-green tint, especially noticeable if the ash is stirred with a glass rod and when the flame is about to go out. (Testing milk and Its Products, Farrington and Wool, p. 247.)

Test for Salicylic Acid (*Salicylates, etc.*) Twenty cubic centimeters of milk are acidulated with sulphuric acid and shaken with ether; the ether solution is evaporated, and the residue treated with alcohol and a little iron-chlorid solution; a deep violet color will be obtained in the presence of salicylic acid. (Testing Milk and Its Products, Farrington and Woll, p. 248.)

Test for Benzoic Acid. Two hundred and fifty to five hundred cubic centimeters of milk are made alkaline with a few drops of lime or baryta water, and then evaporated to about a quarter of the bulk. Powdered gypsum is stirred into the remaining liquid until a paste is formed, which is then dried on the water-bath. The gypsum only serves to hasten the drying, and powdered pumice stone or sand can be used equally well. When the mass is dry, it is finely powdered and moistened with dilute sulphuric acid and shaken out three or four times with about twice the volume of 50 per cent alcohol, in which benzoic acid is easily soluble in the cold, the fat only being dissolved to a very slight extent or not at all. The acid alcoholic liquid from the various extractions, which contains milk-sugar and inorganic salts in addition to the benzoic acid, is neutralized with baryta water and evaporated to a small bulk. Dilute sulphuric acid is again added, and the liquid shaken out with small quantities of ether. On evaporation of the ether, the benzoic acid is left behind in almost pure state, the only impurities being small quantities of fat or ash.

The benzoic acid which is obtained is dissolved in a small quantity of warm water, a drop of sodium acetate and neutral ferric chlorid added, and the red precipitate of benzoate of iron indicates the presence of the acid. (Milk and Dairy Products, Barthel; translated by Goodwin, p. 121).

85. *Detection of Heated Milk.* Certified milk or cream shall not be subjected to heat unless specially directed by the commission to meet emergencies.

86. Tests to determine whether such milks and creams have been subjected to heat shall be applied at least once each month.

Detection of Heated Milk—Storch's Method. Five cubic centimeters of milk are poured into a test-tube; a drop of weak solution of hydrogen dioxid (about 0.2 per cent) which contains about 0.1 per cent sulphuric acid, is added, and 2 drops of a 2 per cent solution of paraphenylendiamin (solution should be renewed quite often), then the fluid is shaken. If the milk or the cream becomes at once indigo blue, or the whey violet or reddish brown, then this has not been heated or, at all events, it has not been heated higher than 78°C. (172.5°F.); if the milk becomes a light bluish gray immediately or in the course of half a minute, then it has been heated to 79° to 80°C. (174.2° to 176°F.). If the color remains white, the milk has been heated at least to 80°C. (176°F.). In the examination of sour milk or sour buttermilk, limewater must be added, as the color reaction is not shown in acid solution.

Arnold's Guaiac Method. A little milk is poured into a test-tube and a little tincture of guaiac is added, drop by drop. If the milk has not been heated to 80°C. (176°F.) a blue zone is formed between the two fluids; heated milk gives no reaction, but remains white. The guaiac tincture should not be used perfectly fresh, but should have stood a few days and its potency have been determined. Thereafter it can be used indefinitely. These tests for heated milk are only active in the case of milks which have been heated to 176°F. or 80°C. (Jensen's Milk Hygiene, Pearson's translation, p. 192.)

Microscopic Test for Heated (Pasteurized) Milk—Frost and Ravenel. About 15 cc. of milk are centrifuged for five minutes, or long enough to throw down the leukocytes. The cream layer is then completely removed with absorbent cotton and the milk drawn off with a pipet, or a fine-pointed tube attached to a Chapman air pump. Only about 2 mm. of milk are left above the sediment which is in the bottom of the sedimentation tube.

The stain, which is an aqueous solution of safranin 0, soluble in water, is then added very slowly from an opsonizing pipet. The important thing is to mix stain and milk so slowly that clotting does not take place. The stain is added until a deep opaque rose color is obtained. After standing three minutes, by means of the opsonizing pipet, which has been washed out in hot water, the stained sediment is then transferred to slides. A small drop is placed at the end of each of several slides and spread by means of a glass spreader, as in Wright's method for opsonic index determinations.

In an unheated milk the polymorphonuclear leukocytes have their protoplasm slightly tinged or are unstained.

In heated milk the polymorphonuclear leukocytes have their nuclei stained. In milk heated to 63°C. or above, practically all of the leukocytes have their nuclei definitely stained. When milk is heated at a lower temperature the nuclei are not all stained above 60°C. The majority, however, are stained.

87. *Specific Gravity.* The specific gravity of certified milk shall range from 1.029 to 1.034.

88. The specific gravity shall be determined at least each month.

The Quevenne lactodensimeter is recommended for the determination of the specific gravity. It is made like an ordinary aërometer and divided into degrees which correspond to a specific gravity from 1.014 to 1.040, or only 1.022 to 1.038, since by the latter division a greater space is gained between the different degrees without unduly lengthening the instrument. From such a lactodensimeter one can easily read off four decimal places.

The milk the specific gravity of which is to be determined is well shaken and poured into a high glass cylinder of suitable diameter; the aërometer is dropped in slowly, in order to prevent its bobbing up and down. (The bulb should be free from adhering air bubbles.) The figures on the stem are the second and third decimals of the numbers of the specific gravity, so that 34 is to be read 1.034. For this examination, the temperature of the milk must be 15°C. (60°F.); if it is not, the specific gravity of the milk at 15°C. must be calculated from the specific gravity found and from the temperature, for in milk inspection and analysis this is the standard.

METHODS AND REGULATIONS FOR THE MEDICAL EXAMINATION OF EMPLOYEES, THEIR HEALTH AND PERSONAL HYGIENE

89. A medical officer, known as the attending dairy physician, shall be selected by the commission, who should reside near the dairy producing certified milk. He shall be a physician in good standing and authorized by law to practice medicine; he shall be responsible to the commission and subject to its direction. In case more than one dairy is under the control of the commission and they are in different localities, a separate physician should be designated for employment for the supervision of each dairy.

90. Before any person shall come on the premises to live and remain as an employee, such person, before being engaged in milking or the handling of milk, shall be subjected to a complete physical examination by the attending physician. No person shall be employed who has not been vaccinated recently or who upon examination is found to have a sore throat, or to be suffering from any form of tuberculosis, venereal disease, conjunctivitis, diarrhea, dysentery, or who has recently had typhoid fever or is proved to be a typhoid carrier, or who has any inflammatory disease of the respiratory tract, or any supurrative process or infectious skin eruption, or any disease of an infectious or contagious nature, or who has recently been associated with children sick with contagious disease.

91. In addition to ordinary habits of personal cleanliness all milkers shall have well trimmed hair, wear close-fitting caps, and have clean-shaven faces.

92. When the milkers live upon the premises their dormitories shall be constructed and operated according to plans approved by the commission. A separate bed shall be provided for each milker and each bed shall be kept supplied with clean bedclothes. Proper bathing facilities shall be provided for all employees on the dairy premises, preferably a shower-bath, and frequent bathing shall be enjoined.

93. In case the employees live on the dairy premises a suitable building shall be provided to be used for the isolation and quarantine of persons under suspicion of having a contagious disease.

The following plan of construction is recommended:

The quarantine building and hospital should be one story high and contain at least two rooms, each with a capacity of about 600 cubic feet and containing not more than three beds each, the rooms to be separated by a closed partition. The doors opening into the rooms should be on opposite sides of the building and provided with locks. The windows should be barred and the sash should be at least 5 feet from the ground and constructed for proper ventilation. The walls should be of a material which will allow proper disinfection. The floor should be of painted or washable wood, preferably of concrete, and so constructed that the floor may be flushed and properly disinfected. Proper heating, lighting, and ventilating facilities should be provided.

94. In the event of any illness of a suspicious nature the attending physician shall immediately quarantine the suspect, notify the health authorities and the secretary of the commission, and examine each member of the dairy force, and in every inflammatory affection of the nose or throat occurring among the employees of the dairy, in addition to carrying out the above-mentioned program, the attending physician shall take a culture and have it examined at once by a compe-

tent bacteriologist approved by the commission. Pending such examination, the affected employee or employees shall be quarantined.

95. It shall be the duty of the secretary, on receiving notice of any suspicious or contagious disease at the dairy, at once to notify the committee having in charge the medical supervision of employees of the dairy farm upon which such disease has developed. On receipt of the notice this committee shall assume charge of the matter, and shall have power to act for the commission as its judgment dictates. As soon as possible thereafter, the committee shall notify the commission, through its secretary, that a special meeting may be called for ultimate consideration and action.

96. When a case of contagious disease is found among the employees of a dairy producing certified milk under the control of a medical milk commission, such employee shall be at once quarantined and as soon as possible removed from the plant, and the premises fumigated.

When a case of contagion is found on a certified dairy it is advised that a printed notice of the facts shall be sent to every householder using the milk, giving in detail the precautions taken by the dairyman under the direction of commission, and it is further advised that all milk produced at such dairy shall be heated at 145°F. for forty minutes, or 155°F. for thirty minutes, or 167°F. for twenty minutes, and immediately cooled to 50°F. These facts should also be part of the notice, and such heating of the milk should be continued during the accepted period of incubation for such contagious disease.

The following method of fumigation is recommended:

After all windows and doors are closed and the cracks sealed by strips of paper applied with flour paste, and the various articles in the room so hung or placed as to be exposed on all sides, preparations should be made to generate formaldehyd gas by the use of 20 ounces of formaldehyd and 10 ounces of permanganate of potash for every 1000 cubic feet of space to be disinfected.

For mixing the formaldehyd and potassium permanganate a large galvanized-iron pail or cylinder holding at least 20 quarts and having a flared top should be used for mixing therein 20 ounces of formaldehyd and 10 ounces of permanganate. A cylinder at least 5 feet high is suggested. The containers should be placed about in the rooms and the necessary quantity of permanganate weighed and placed in them. The formaldehyd solution for each pail should then be measured into a wide-mouthed cup and placed by the pail in which it is to be used.

Although the reaction takes place quickly, by making preparations as advised all of the pails can be "set off" promptly by one person, since there is nothing to do but pour the formaldehyd solution over the permanganate. The rooms should be kept closed for four hours. As there is a slight danger of fire, the reaction should be watched through a window or the pails placed on a non-inflammable surface.

97. Following a weekly medical inspection of the employees, a monthly report shall be submitted to the secretary of the medical milk commission, on the same recurring date by the examining visiting physician.

The following schedule, filled out in writing and signed by himself, is recommended as a suitable form for the attending physician's report:

This is to certify that, on the dates below indicated, official visits were made to the ——— dairy, owned and conducted by ——— of ——— (indicating town and State), where careful inspections of the dairy employees were made.

(*a*) Number and dates of visits since last report. ———.
(*b*) Number of men employed on the plant. ———.
(*c*) Has a recent epidemic of contagion occurred near the dairy, and what was its nature and extent? ———.
(*d*) Have any cases of contagious or infectious disease occurred among the men since the last report? ———.
(*e*) Dispositon of such cases. ———.
(*f*) What individual sickness has occurred among the men since the last report? ———.
(*g*) Disposition of such cases. ———.
(*h*) Number of employees now quarantined for sickness. ———.
(*i*) Describe the personal hygiene of the men employed for milking when prepared for and during the process of milking. ———.
(*j*) What facilities are provided for sickness in employees? ———.
(*k*) General hygienic condition of the dormitories or houses of the employees. ———.
(*l*) Suggestions for improvement. ———.
(*m*) What is the hygienic condition of the employees and their surroundings? ———.
(*n*) How many employees were examined at each of the foregoing vists? ———.
(*o*) Remarks.

——— ———,
Attending Physician.

Date,———.

b. Inspected Milk. Inspected milk includes clean, raw milk, skim milk or cream produced on a dairy farm complying with the following or similar requirements, when official: The diary farm should score at least 70 on a standard score card upon an examination made by a recognized, graduate veterinarian. All bovines on the diary farm should be free from tuberculosis and other diseases as shown by proper tuberculin tests and physical examinations conducted by a qualified veterinarian. Cows should have the long hair clipped from the udder, flanks and tail (sufficient to clear the ground). The cows should be fed, watered, stabled and milked under proper, sanitary conditions. Objectionable foods include refuse from any brewery or distillery, slops, glucose or malt in a state of decomposition or fermentation, or other unwholesome articles. The milk from cows fifteen days prior to and seven days after, parturition should be excluded. Personnel coming into contact with milk or utensils involved should be free from disease as shown by medical examination, scrupulously clean, clothed in a sanitary manner and acquainted with full sanitary requirements. Illness of any person on the dairy farm should be reported immediately for medical examination. Milking machines and utensils should be of sanitary construction, clean

and sterilized before using. The milk should be removed from the stable immediately after milking, cooled to 50°F. or below, placed into sterilized final containers and kept at 50°F. or below until it reaches the consumer. The bacterial count of inspected milk should not exceed 100,000 per cubic centimeter.

c. Pasteurized Milk. Pasteurized milk includes whole milk, skim milk and cream produced on dairy farms not capable of meeting the requirements of certified or inspected milk, and complying with the following or similar requirements, when official: Milk derived from a filthy dairy or one scoring less than 55 on a standard score card, upon an examination made by a recognized, graduate veterinarian, should not be used for pasteurization. All bovines on the dairy farm should be free from visible signs of disease as shown by a thorough physical examination conducted by a qualified veterinarian. The sanitary requirements of feeding, watering, housing and milking cows; of personnel, utensils and handling the milk after milking as described under "a. Inspected Milk" should apply to milk to be pasteurized.

Raw milk or skim milk to be pasteurized should not contain bacteria in excess of 750,000 per cubic centimeter and raw cream not more than 800,000 per cubic centimeter. All products to be pasteurized should be entirely free from pathogenic organisms, blood, pus, soluble filth and other objectionable properties. A pint sample of the product to be pasteurized when filtered through a pledget of cotton 1 inch in diameter should yield not more than a perceptible sediment or stain other than that of natural milk fat.

Pasteurization plants should be efficient and meet all sanitary requirements as to construction, equipment, personnel, products and methods of operation. Standard temperature recording apparatus should be installed upon all pasteurizers and kept in good working condition. Record charts made should be dated and filed. A clarifier may be used prior to pasteurization.

The quantity of milk exposed at one time, the temperature of pasteurization and the time of exposure, should be such as will result in the destruction of 99 per cent of bacteria, and all pathogenic and colon organisms in the product. A uniform heating of the milk at 145°F. for thirty minutes, at 160°F. for five minutes or a momentary exposure of 180°F. usually are considered sufficient. After pasteurization the milk should be cooled to 50°F. or below, placed into sterile bottles and kept at 50°F. or below until delivered to the consumer. Pasteurized milk and skim milk upon delivery should not contain bacteria in excess

of 50,000 per cubic centimeter and pasteurized cream not more than 150,000 per cubic centimeter. Pasteurized milk and cream should show no B. coli in 1 cubic centimeter as shown by proper laboratory methods. Bottles should be labeled properly and show the date of pasteurization.

3. Army Requirements. The responsibility of the veterinary corps in connection with the fresh milk supply of troops is limited to the examination of the dairy herds and farms from which the milk is obtained, also collecting depots and creameries. The sanitary handling and inspection of fresh milk after it leaves the hands of the dairyman, except that intended for prepared products, is regarded as within the jurisdiction of the sanitary officer. (See Chapter II, Station Service.)

The hygienic condition of fresh milk depends to a considerable degree upon the conditions existing at the source of supply. Insanitary milk due to diseased animals or contamination at the source, is correctible only in part, therefore it is necessary that milk be obtained from healthy cows and produced and handled under hygienic conditions, even when it is pasteurized. Pasteurization may destroy micro-organisms to some extent in milk, thereby decreasing the live germ content of such milk, but it will not remove all the poisonous products from diseased udders or from disease producing bacteria in milk, nor will it remove objectionable organic material in soluble form introduced at the dairy during milking or handling. Since these conditions have a direct bearing upon the health of the consumers, pasteurization is not an accepted substitute for dairy farm inspection.

Medical Department laboratory reports of bacterial analyses of milk samples forwarded by Army veterinarians may act as a guide in determining the suitability of a particular dairy farm as an approved source of milk supply for troops, but bacterial counts of milk samples taken after pasteurization or upon delivery to a station are not considered as meeting dairy farm inspection requirements.

a. Sanitary Dairy Farm Inspection. A veterinary dairy farm examination consists of an investigation into the sanitation of the dairy farm establishment and all parts, equipment, employes, health and hygiene of dairy animals, methods of operation, and products concerned. Such inspections may be required at depots or procurement points, in connection with the investigation of the sanitary source of dairy products offered for purchase, also with commands in the field and at stations. The object of such examination is to protect the health of troops by insuring an adequate degree of sanitary supervision of milk production at its

source, through prompt detection of insanitary conditions and the initiation of proper corrective measures. The salient features of correct, sanitary and health standards representing desirable objectives to be attained are as follows:

(1) Barn Yard. The premises should be examined as to sanitary location, drainage, disposal of waste in relation to the source and location of the water supply, and freedom from contaminating surroundings and nuisances.

(2) Barn. The type of construction, arrangement, suitability, state of repair and cleanliness of the ceilings, walls, floors, mangers, ties, gutters, etc., should be considered, also the system and efficiency of ventilation, and method and adequacy of lighting facilities.

Sanitary standards include the following requirements: Ceilings and walls should be tight and smooth, constructed of materials which permit of ready cleansing, clean and in good state of repair. Doors and windows should be screened properly. There should be at least 2 square feet of window space per animal for lighting purposes. The floor should be made of non-absorbent material, tight, in good repair, properly graded and drained. The gutter should be of non-absorbent material, properly constructed as to width, depth, pitch and outlet and in a good state of repair. Ties and mangers should be of proper construction and arranged conveniently. At least 600 cubic feet of air space is desired per animal, with provision for proper air circulation to insure 3,600 cubic feet of air per animal per hour. The temperature should be noted as well as the odor of the stable. The latter is a good test for cleanliness and the sufficiency of ventilation.

(3) Stable Hygiene. Ceilings, walls, ledges and partitions should be kept free from cobwebs, dust and scaling whitewash. Window panes should be washed frequently. Floors, gutters and mangers should be cleaned thoroughly at least one time a day and all cleaning completed one-half hour before the commencement of the milking period. After cleaning, the floors should be broom-swept to remove all loose dirt, then sprinkled or flushed with clean water. All solid and liquid dejecta and effete materials should be removed if possible to the fields or so treated as to inhibit fly propagation. In any event it should be stored at least 100 feet beyond the barn and milk house, at a place inaccessible to the dairy herd and where it will not overflow the premises adjacent to the barn or milk house.

When animals are confined in a stable or barn, cleaning of the floors and gutters should be conducted at least two times each day.

Bedding, forage, utensils, vehicles and other implements should not be stored in the stable.

(4) Milking Room. A separate room or building used for milking purposes should meet the same sanitary requirements as discussed for a stable wherein cows are milked.

(5) Lavatory and Toilet Facilities. Privies, urinals and lavatories for personnel should be of sanitary location and construction, properly equipped, kept clean and provision made for proper waste disposal and fly exclusion. A privy should be of cement box type, with hinged seat lids of tight construction, automatically closing doors and absolutely fly and vermin proof. There should be adequate hot and cold running water facilities, soap and towels.

(6) Milk House. A milk house should be provided wherein milk as soon as drawn can be cooled and aerated and otherwise handled and stored, and where utensils can be cleaned, sterilized and then stored. It should be separate from the barn, dwelling house, boiler room, coal bin and lavatory; situated well apart from and on higher ground than outhouses, manure piles, hog pens and stables; and away from dusty highways or dirt roads. It should be of sanitary construction, used solely for the purpose intended, thoroughly screened against flies and other vermin, free from abnormal odors and filthy utensils, and properly drained.

Water used for cooling or washing purposes should be pure and its source free from all possible contamination from manure piles, hog pens, privies, surface drainage, etc. The supply of both hot and cold water should be adequate and convenient.

Ample and conveniently located facilities should be provided for aerating the milk and reducing its temperature to 60°F. and whenever possible to 50°F. or less. The cooler or aerator should be protected from dust, odors and flies and should not be used out of doors or in the barn.

(7) Equipment and Utensils. All apparatus, equipment and utensils should be examined as to type, suitability, state of repair, adequacy, facilities for cleansing and sterilization, and their cleanliness. The material used in utensils and their construction should be such as to provide for easy cleaning and sterilization. Small-top milking pails of heavy, seamless tin or with flush, smooth seams, are preferable. Containers made of wood, galvanized iron or other porous or rough material are insanitary. Damaged, leaking or rusty cans or those having damaged or ill fitting covers, and all other utensils having openings or rough surfaces, whereby milk may be contaminated or dirt collect, are insanitary. Plenty of suitable, sanitary filters should be provided in order to replace those which become soiled.

After each milking all apparatus, utensils and bottles should be cleaned thoroughly and if possible sterilized with live steam. At least they should be rinsed in cold water, washed with a hot alkaline or soapy solution, rinsed in boiling water, then inverted in a clean place, free from flies, odors, and other obnoxious factors. Filter cloths and strainers should be washed in cold water, boiled and dried. After using, milking machines should be taken apart, cleaned, sterilized and properly stored.

(8) Personnel. Milkers and milk handlers should be free from communicable disease and efforts should be made through medical examination to insure that they are not carriers of typhoid or other diseases. All personnel engaged on a dairy farm should be required to report cases of communicable diseases in their home. Veterinary officers should bring at once to the attention of the station surgeon the existence or suspected existence of communicable diseases among such personnel or their families.

The hands of milkers should be free from open wounds and should be washed thoroughly with water, soap and brush, rinsed well and dried on a clean towel just before milking. Moistening the hands with milk is insanitary. Milk handlers should be clean in person and clothing. Clean outer garments free from street, outside or stable dust should be worn when milking and handling the milk and used exclusively for this purpose. No part of the clothing or person should come into contact with the milk or the inside of the container. When not in use outside clothing should be stored in a clean and sanitary place.

(9) Milking and Handling the Milk. The veterinarian should investigate the efficiency of sanitary procedures at time of milking as to restraint of cows, cleanliness of udders and teats, hands of attendants and milking machine, and the method of operating milking machines or hand milking, straining the milk, its separation, cooling, bottling, storage and transportation.

Before milking, udders and teats should be brushed, then wiped with a clean cloth and warm water and never moistened or cleaned with milk. The first streams of milk from each teat should be rejected due to the enormous number of bacteria. Milking should be done rapidly and quietly. Provision should be made to prevent teat cups from floor contamination, upon becoming detached.

As soon as drawn, the milk from each cow should be removed from the stable or milk room to the milk house, there immediately passed over the aerator and cooled to 60°F. and preferably to 50°F. or below. This temperature should be maintained until the milk reaches the consumer or pasteurization plant.

Can containers should be covered tightly and the lids wired and sealed. Broken, damaged, worn or poorly fitting lids should not be used. Each can or bottle should be labeled properly before leaving the dairy farm.

Vehicles or other conveyances used for transporting fresh milk or cream to receiving station should be cleaned and kept covered, and suitable measures adopted for keeping the milk below 50 to 60°F.

(10) Hygiene of Dairy Animals. The feeds, feeding, water, watering, bedding, grooming and exercise of dairy cows have an important bearing on the health of the animals and the sanitary quality of the milk supply.

Forage should be sound, suitable, of good quality, clean and free from dust, mold, decomposition, fermentation or other objectionable properties. Feeding floors, racks, boxes or mangers should be kept free from dust, rubbish and old feed. Dry forage, associated with dust should not be fed just prior to or during the milking period.

The water supply should be pure and adequate. Drinking basins and watering troughs should not become insanitary and should be cleaned out at least 2 times each week.

Bedding should consist of clean, dry straw, shavings, fodder, leaves or other approved absorbent material. Horse manure is objectionable. Daily grooming is desirable. Long hairs should be clipped from the flanks, udder and the tail hairs so cut that the brush clears the floor. At time of milking the venter surfaces, udder, flanks, legs and tail should be free from manure, mud, dirt or other filth.

Dairy cows should be turned out for exercise in a clean yard at least two hours each day.

Sick, diseased, and parturient cows, also horses, poultry and other domestic animals excepting healthy calves and bulls, should be excluded from cow stables and exercise yards.

(11) Diseases of Dairy Animals. (a) Physical Examinations. Whenever desirable or necessary a veterinary officer should carefully scrutinize dairy animals as to their condition of health. This would include a complete physical examination of all animals in a herd when approved as a source of supply, also prior to giving the tuberculin test. When a tuberculin reactor is found in a herd unusually frequent physical examinations should be conducted.

Physical and laboratory examinatons of the milk may be made at any time after milking up to a point where the milk leaves the hands of the dairyman.

(b) Tuberculin Testing. It is desirable to limit the milk supply to dairy farms, the animals of which have passed successfully a tuberculin test as recognized and conducted by the United States Department of Agriculture in coöperation with various states under the tuberculosis-

free, accredited herd system. Veterinary officers should be familiar with all local standards of sanitary livestock disease control and should so far as possible recommend the restriction of the supply to accredited herds, accepting the results of tests and control measures instituted unless manifestly contrary to Army Regulations, or unreliable. Where-ever the accredited herd system is not in operation, an effort should be made to obtain equivalent standards in the territory from which the milk supply is derived.

A station veterinarian with the approval of the commanding officer may render such assistance to local authorities in connection with the tuberculin tests of privately owned animals under the accredited-herd system as will be of manifest advantage to the Government in improving the quality of milk, but the expense of such tests including all supplies is not thought to be a proper charge against War Department funds.

Public dairy animals should be tuberculin tested at least one time each year in accordance with recognized methods as modified by existing Army Regulations using only intradermal tuberculin, ophthalmic tuberculin discs or other tuberculin as furnished by the Army Medical School. Should both forms of tuberculin not be available, the intradermal test alone may be used, but the use of the ophthalmic test alone is not authorized.

Technique of Test. The left caudal fold, properly cleaned and disinfected with an application of tincture of iodin, is used as the site of injection. The right caudal fold is used for a control. Two or not more than three minims of intradermal tuberculin are injected into the dermis in the superficial layers, using the same type of syringe, needle and aseptic precautions as prescribed for the injection of mallein. (Army Regulations, 40–2110, par. 2.)

For the purpose of sensitization, an ophthalmic tuberculin disc is placed at the same time in the supero-posterior portion of the left conjunctional sac beneath the upper eyelid, and hourly observations made from the fifth to the twelfth hour after its insertion.

At the seventy-second hour afterwards, a second ophthalmic disc is inserted into the sensitized eye and hourly observations made from the fifth to the twelfth hour after its injection.

Observation of the site of injection on the left caudal fold is observed at the seventy-second hour and in doubtful cases, as often thereafter as deemed necessary. Should a suspicious or positive case develop in an animal of a herd, a second reading of the entire herd should be made at the one hundred and twentieth hour and a third reading at the one hundred and forty-fourth hour after injection.

Retests should not be made within sixty days.

Interpretation of Results. Reactions are recorded as positive, suspicious and negative.

Positive. A positive intradermal reaction as noted at one or more of the prescribed observations, may consist of a circumscribed swelling of the injection site $\frac{3}{16}$ inch ("pea size") or greater in diameter, or, a diffuse swelling of the injected caudal fold two times the thickness of the normal fold. A positive ophthalmic reaction consists of acute conjunctivitis with mucopurulent or purulent discharge, sometimes with swelling of the eyelid, as observed at one or more of the prescribed observations. An animal reacting to either or both tests is considered as infected with tuberculosis.

Suspicious. A circumscribed swelling at the injection site less than $\frac{3}{16}$ inch in diameter, a diffuse swelling of the injected fold less than two times the normal thickness of the fold, or a slight conjunctivitis with or without a slight serous discharge, present at one or more of the prescribed observations, would constitute a suspicious reaction, and the animal would be considered as possibly having tuberculosis.

Negative. A negative reaction is indicated by an absence of a circumscribed or diffuse swelling of the left caudal fold at the site of injection and an absence of acute conjunctivitis, discharge and swelling of the eyelid, at all of the prescribed observations. An animal presenting a negative reaction is considered as free from the infection of tuberculosis at time of the test.

Recording Results. Intradermal reactions are recorded in accordance with the official code of the United States Livestock Sanitary Association as follows: Suspicious reactions should be recorded as suspicious and described in detail. For positive reactions the following should govern: For circumscribed swellings, "pea size" (diameter $\frac{3}{16}$ inch) is used as the basic standard. Larger swellings are recorded as "P-2," "P-3," "P-4," etc. (the figures 2, 3, 4 referring to twice, thrice, and four times the diameter of a pea). For diffuse swellings "Thick 2 X" is used as the basic standard and signifies a diffuse swelling in which the injected caudal fold is twice as thick as the normal fold. Larger swellings are recorded as "Thick 3X," etc.

Charts of tuberculin tests should be prepared and forwarded in compliance with Army Regulations.

(12) Score Card. One score card which has been suggested for use by Army veterinarians follows: A score of 90 or above is considered excellent, 80 to 89 good, 60 to 79 medium and below 60 poor.

Report of Inspection of Dairy Farm

Owner
Operator............................P.O....................................
Milk delivered to.............................by..........................
(Military station) (Name of distributor or dealer)
of....................... Date of inspection......................

Score Card for Equipment and Methods

	Score: Perfect	Score: Allowed
A. Barn and Yard		
1. Barn: Site, well drained, and free from contaminating surroundings....................................	1	
2. Construction of barn:		
Tight, sound floor and proper gutter, tie and manger....	3	
Smooth, tight walls and ceiling......................	2	
3. Light: Four sq. ft. or more of glass per cow, and adequate artificial lighting for milking.......................	3	
(Three sq. ft., 2; two sq. ft., 1)		
4. Ventilation: Automatic system.........................	2	
(Adjustable windows, 1)		
Cubic feet of air space per cow, 1,000 to 600.........	2	
(500 to 600, 1)		
Stable air..	2	
5. Cleanliness:		
Floor..	2	
Walls..	1	
Ceiling and ledges..................................	1	
Mangers and partitions..............................	1	
Windows...	1	
Bedding...	2	
6. Water for cattle: Clean and fresh.....................	1	
7. Yard: Free from manure, clean and well drained........	2	
(Manure stored less than 50 feet from barn 0)		
8. Lavatory and toilet facilities:		
(To include accommodations for employees.)		
Lavatory: soap, water and towel.....................	2	
Location, Construction and Cleanliness of toilet; Disposal of Contents..................................	2	

Score Card for Equipment and Methods—Continued

	SCORE	
	Perfect	Allowed
B. Milk House		
1. Site: Free from contaminating surroundings, with separate wash rooms	1	
2. Convenience	1	
3. Construction of floor, walls and ceiling	1	
4. Light, ventilation and screens	1	
5. Cleanliness of milk room, including freedom from flies	3	
C. Utensils		
1. Small top milking pail (*Removable top, 5*)	10	
2. Facilities for sterilization: (steam, 10; boiling water, 5)	10	
3. Thorough cleansing and sterilizing of utensils	10	
4. Milk cooler	1	
5. Constructon: Sound, of good type and in good repair	1	
6. Water for cleaning, unpolluted, clean, convenient, and sufficient	2	
D. Milking and Milk		
1. Udders washed and dried (Cleansed with moist cloth, 2)	6	
2. Attendants: Cleanlness and apparent health	2	
2a. Med. Insp. Employes	3	
3. Clean milking suits	1	
4. Milk of each cow removed immediately from stable	2	
5. Prompt cooling	4	

	Score Perfect	Score Allowed
6. Efficient cooling; below 50°F........................ (51°F to 55°F. 2; 56°F to 60°F, 1)	5	
7. Storage; below 50°F..................................	3	
8. Transportation from farm to station: iced................ (Jacket or wet blanket, 2; dry blanket or covered wagon, 1)	3	
Total..	100	....

Score Card for Cattle

No. of dairy cattle in herd	Perfect score for each cow and bull, 100	Total possible score for herd
....		....

DEDUCTIONS ON ACCOUNT OF DISEASE, ETC.

Number of cattle	Nature of disease, defect, etc.	Deductions per cow	Total deductions
	1. Tuberculosis as shown by physical examination or by tuberculin test..........	100	
	2. Absence of a tuberculin test within one year of date inspection (not to include cattle scored under 1).................	30	
	3. Inflammatory diseases of the udder.....	100 or less	
	4. Diseases other than or in addition to the diseases mentioned above.............	100 or less	
	5. Unclean condition of the teats and udders	40 or less	
	6. Unclean condition of cows other than specified in 5.........................	30 or less	
	7. Undue emaciation or cows otherwise out of condition............................	10 or less	
Total deductions			
Total possible score for herd...................... Total deductions.............................. Net score..................................			
Net score........divided by total possible score for herd........equals percentage score			

Recommendations: ....
....
....

....
(Signature)

....
(Rank)

....
(Official designation)

(13) Action. (See Chapter II, Station Service.) Milk from a parturient animal for fifteen days before until eight days after parturition should be rejected. When milk from a cow is bloody, stringy or otherwise abnormal, it should be rejected and the cow isolated until the cause of such abnormal milk is determined and removed. Cows undergoing medical treatment should be excluded as a source of supply.

Dairy animals affected with cow pox, foot-and-mouth disease, rabies, anthrax, actinomycosis, mastitis, trembles, infectious abortion, retained secundines, gangrenous pericarditis, pneumonia, septic or hemorrhagic enteritis, septic metritis, diarrhea, any disease or condition associated with marked systemic disturbance, suppurating wounds, and ulcerative or phlegmonous inflammation should be removed from the herd and the milk rejected. In the case of communicable disease, quarantine measures should be taken and local sanitary livestock authorities notified. Quarantined premises and buildings should be subjected to such prophylactic, cleaning, disinfecting or other control measures as are necessary to prevent the spread of disease. Affected animals should not be restored to the herd or used as a source of milk supply until found to be in good health after a rigid veterinary physical examination.

When tuberculosis in a dairy herd is determined by physical or laboratory examination, or by means of the tuberculin test, the following action should govern: In the case of civilian owned animals, positive and suspicious cases are disposed of by local authorities in the manner prescribed by the Federal, state, municipal or other law under which they are tested. The veterinary officer should advise the civilian owner that a positive case should be excluded permanently as a source of milk supply for troops, that a suspicious reactor should be excluded until the case is cleared up, and that until all positive cases and suspicious reactors are removed from the dairy farm and herd the milk from the entire herd should not be used for human consumption. When positive cases or suspicious reactors are found in barns, they should be removed, the barns cleaned and disinfected, and the owner advised not to add to their herds any dairy animals which have not passed a satisfactory tuberculin test.

When these requirements are not met, the veterinarian immediately should recommend to the commanding officer, through the surgeon, that the milk of the entire herd be excluded from the command.

Reacting public animals should be destroyed without delay in accordance with Army Regulations. Suspicious reactors should be removed at once from the herd, excluded as a source of milk supply, placed into isolation under quarantine and retested every sixty days until determined to be positive or negative cases. Public herds in which

positive reactors are found should be tested every six months, supplemented with very thorough physical examinations to detect early clinical signs of the disease.

When milkers or handlers are affected with communicable disease, or when insanitary conditions pertaining to the construction and location of the establishment, the equipment or methods of handling the milk, do not insure a clean and wholesome product, the milk should be rejected.

Failure on the part of any dairy farm or milk herd to comply with complete sanitary requirements should be made the basis for veterinary recommendation that such establishment be not approved as a source of milk supply and that the product be not approved for the use of troops.

b. Collecting Depots, Creameries and Pasteurizing Plants. The following score card as used by the City of Chicago, Illinois, is applicable to sanitary inspection of receiving or collecting depots and creameries including pasteurizers:

EQUIPMENT		SCORE	
		Perfect	Allowed
Location		10	....
Surroundings: Clean 3, grass covered 1	4		
No open privies nearer than 300 feet	6		
Construction		15	....
Floor: Iron plate 4, cement 3, tile or brick 2, wood 1	4		
Floor free from defects	2		
Walls and Ceilings: Tile, cement, enameled metal and enameled wood	4		
Plaster 1, rough wood 0			
Walls free from defects	2		
Fly screens on hand	3		
Sanitation		15	....
Light: Window area 15% of floor space	4		
Ventilation: Working system 6, windows 3			
Drainage : Ample 1, trapped 2, to 300 ft. away 2......	5		
Pasteurizer and Cooler		15	....
Process: Held 4, continuous 3	4		
Feed: Regulated and fixed	2		
Automatic thermo-regulator	3		
Automatic thermo-register	3		
Easily cleaned and little piping	3		

EQUIPMENT		Score: Perfect	Score: Allowed
Separators and Filters		3	....
Easily cleaned	3		
Bottle Filler		5	....
Automatic 5, hand 3	5		
Bottle Washer		5	....
Machine 5, hand 4	5		
Other Utensils		5	....
Smooth and well plated	3		
Free from rust and defects	2		
Milk Pumps and Pipes		10	....
Joints: All crosses 6, others readily taken apart 3	6		
Smooth inner surface and plated	4		
Water and Ice Supply		10	....
Water: From deep well 5, spring 4, city main 3, running steam 2	5		
Ice: Artificial 5, natural 3, (Allow 5 if water or ice supply has been examined and passed by Dept.)	5		
Dressing Room		7	....
Hot and Cold water	2		
Sanitary lavatory, soap and towels	2		
Uniform working suits and caps	3		
Total		100	....

METHODS		Score: Perfect	Score: Allowed
Buildings		25	....
Cleanliness:			
Walls—painted 1, clean 2	3		
Ceilings " 1, " 2	3		
Floors, including corners	4		
Windows, including ledges	2		
Ledges, free from dust	2		
Free from flies	8		
Free from odor	3		

METHODS		SCORE Perfect	SCORE Allowed
Apparatus		25	....
Cleanliness:			
Pasteurizer and cooler	5		
Separators and filters	5		
Bottle fillers	5		
Bottle washers	2		
Bottle rinsing tubs	4		
Weighing and receiving vats	2		
Pumps and pipes	2		
(Deduct 10 points from score allowed if any of the utensils are not sterilized.)			
Containers		20	....
Bottles:			
Well soaked and washed	3		
Rinsed in running water and drained	3		
Sterilized—live steam 10, dry heat 8	10		
Shipping crates washed	2		
Farmers' cans rinsed and washed	2		
(Deduct 10 points if farmers' cans are not thoroughly cleaned and sterilized.)			
Handling of Milk		10	....
Protection from dust and flies:			
Covered vats	4		
Covered aerators and coolers	4		
Bottle caps protected	2		
Cooling and Storage		10	....
Below 50°F	10		
From 51°F. to 55°F	8		
From 56° F. to 60°F	4		
Above 60°F	0		
Employes (Handling Milk)		10	....
Clothing clean	4		
Hands clean	4		
Hands free from sores	2		
(Deduct 5 points from score allowed for smoking or expectorating in workroom.)			
Total		100	....

Score of Equipment..............Multiplied by 1 = ...

Score of Methods................Multiplied by 2 = ...

Total.............divided by 3 = ...Final Score.

Signed...(In full)
(Food Inspector)

The following score card as used by the City of Chicago, Illinois, is applicable to the sanitary inspection of pasteurizing depots:

EQUIPMENT		SCORE	
		Perfect	Allowed
Location		5	....
Deduct if opening into—			
Store	1		
Living Room	2		
Kitchen	2		
Laundry	3		
Located in basement	3		
Cellar	5		
Toilet opening into depot	5		
Opening into barn	5		
Construction		20	....
Floor:			
Cement	5		
Wood	3		
Tile	2		
Brick	0		
Smooth and free from defects	5		
Walls and Ceiling:			
Enameled metal, wood, tile	7		
Cement	6		
Plaster	3		
Brick	2		
Smooth and free from defects	3		
Washroom:		15	....
Situated so that dirty utensils do not pass through milk room	3		
Smooth tubs	3		
Revolving brushes	5		
Rinsing and draining facilities	4		
Screens in Fly Season		5	
Sanitation		8	....
Light: Window area equal to 15% of floor area. Deduct 1 for every 2% less.			
Ventilation:		5	....
Free from odors	5		
Odors in depot	0		
Drainage:		10	....
Ample	5		
Trapped to sewer by deep seal trap	5		

EQUIPMENT		SCORE	
		Perfect	Allowed
Sanitation—Continued		7	....
Vats and Refrigerators:			
Impervious construction and well covered	4		
Indirectly trapped to sewer	3		
Apparatus:		20	....
Bottle Filler:			
Machine	3		
Hand	2		
Bottle Capper:			
Machine	3		
Hand	0		
Milk Pumps and Pipes:			
Readily taken apart and cleaned	3		
Pipe Connections:			
All crosses or tees	3		
Pasteurizer:			
Easily cleaned	3		
Depot equipped with sterilizing apparatus	4		
Bottle Caps in clean, covered receptacle	1		
Dressing Room:		5	....
Hot water, soap and towels	2		
Sanitary lavatory	2		
Uniform working suits	1		
Total		100	....

METHODS		SCORE	
		Perfect	Allowed
Milk and Washroom		20	....
Cleanliness:			
Surroundings clean	1		
Floors, including corners	2		
Walls, clean	1		
Ceiling	2		
Windows and ledges	1		
Refrigerator and Storage vats	5		
Depot free from flies	5		
Depot free from odor	3		
Utensils and Apparatus		55	....
Cleanliness:			
Pasteurizer and Cooler:			
Clean	2		
Sterilized	3		

METHODS		SCORE	
		Perfect	Allowed
Utensils and apparatus—Continued			
Separator and Clarifier:			
Clean	2		
Sterilized	3		
Bottle Filler:			
Clean	2		
Sterilized	3		
Pumps and Pipes:			
Clean	2		
Sterilized	3		
Receiving Vats:			
Clean	2		
Sterilized	3		
Farmers' Cans:			
Clean	2		
Sterilized	3		
Bottles:			
Well soaked, washed, rinsed in running water and drained	5		
Sterilized	5		
Cans for Storing:			
Clean	5		
Sterilized	5		
Shipping Crates:			
Washed and rinsed	2		
Bottle caps properly stored	3		
Handling of Milk		15	....
Protection from Dust and Flies:			
Windows covered with muslin	3		
With wire cloth	2		
Covered vats	2		
Clean hands	3		
Clean suits	2		
No expectorating in depot	1		
Bottling machine kept covered	2		
Storage:		10	
Below 50°F	10		....
Below 60°F	5		
Above 60°F	0		
Total		100	

Score of Equipment..............Multiplied by 1 = ...

Score of Methods...............Multiplied by 2 = ...

Total.................÷ 3 = ...Final Score

Inspector..

A score card for milk as suggested by the Connecticut Agricultural College, and modified, follows: however in all instances there should be considered the sanitary source, pathogenic bacteria and other factors as discussed under 3 above.

SCORE CARD FOR MILK

Place.................................... Date............................
Source of Samples..
Address..

ITEM	PERFECT SCORE	SCORE ALLOWED	CONDITIONS FOUND
Bacterial count......	35		Number per cubic centimeter
Flavor and odor.......	25		Flavor, odor
Sediment test.........	10		
Fat..................	10		Per cent found
Solids not fat........	10		Per cent found
Acidity...............	5		Per cent found
Bottle and cap.......	5		

DIRECTIONS FOR SCORING

Bacteria Per Cubic Centimeter.

5,000 and under...35.0	40,001 to 45,000...28.0	110,001 to 115,000...15.0
5,001 to 7,000.....34.5	45,001 to 50,000...27.5	115,001 to 120,000...14.0
7,001 to 9,000.....34.0	50,001 to 55,000...27.0	120,001 to 125,000...13.0
9,001 to 11,000.....33.5	55,001 to 60,000...26.0	125,001 to 130,000...12.0
11,001 to 13,000.....33.0	60,001 to 65,000...25.0	130,001 to 135,000...11.0
13,001 to 15,000.....32.5	65,001 to 70,000...24.0	135,001 to 140,000....9.5
15,001 to 17,000.....32.0	70,001 to 75,000...23.0	140,001 to 150,000....8.0
17,001 to 19,000.....31.5	75,001 to 80,000...22.0	150,001 to 160,000....7.5
19,001 to 21,000.....31.0	80,001 to 85,000...21.0	160,001 to 170,000....5.0
21,001 to 23,000.....30.5	85,001 to 90,000...20.0	170,001 to 180,000....3.5
23,001 to 25,000.....30.0	90,001 to 95,000...19.0	180,001 to 190,000....2.0
25,001 to 30,000.....29.5	95,001 to 100,000...18.0	190,001 to 200,000....1.0
30,001 to 35,000.....29.0	100,001 to 105,000...17.0	Over 200,000........0.0
35,001 to 40,000.....28.5	105,001 to 110,000...16.0	

FLAVOR AND ODOR.

Deductions for disagreeable or foreign odor or flavor should be made according to conditions found. When possible to recognize the cause of the difficulty it should be described under "Remarks."

SEDIMENT TEST

The sediment test is made by straining a pint of milk through a cotton disk of uniform diameter which is attached to the bottom of the tester. The amount of dirt that collects on the disk shows the amount that was contained in that pint of

milk. The presence of a mere speck makes a perfect score impossible. Further deductions are made according to the amount of dirt found.

FAT IN MILK

3.5 per cent and over, 10 points; 3.45 per cent, 9 points; 3.4 per cent, 8 points; 3.35 per cent, 7 points; 3.3 per cent, 6 points; 3.25 per cent, 5 points; less than this, 0. (legal standard.)

SOLIDS NOT FAT

8.7 per cent and over, 10 points; 8.6 per cent, 8 points; 8.5 per cent, 6 points; Less than this, 0. (Legal standard.)

ACIDITY

0.2 per cent and less, 5 points; 0.21 per cent, 4 points; 0.22 per cent, 3 points; 0.23 per cent, 2 points; 0.24 per cent, 1 point; over 0.24 per cent, 0.

BOTTLE AND CAP

Bottle should be made of clear glass and free from attached metal parts. Caps should be sealed in their place with hot paraffin, or both cap and top of bottle covered with parchment paper or other protection against water and dirt. Deduct for tinted glass, attached metal parts, if rusty, unprotected or leaky caps, partially filled bottles, or other conditions permitting contamination of milk or detracting from the appearance of the package.

Whenever deemed necessary, milk samples for bacteriological, chemical or other examination should be collected properly and forwarded to a Medical Department laboratory in accordance with Army Regulations.

c. Procurement Specifications. Two War Department specifications under date of May 10, 1919, are quoted in part as follows: however, in each instance the current purchase requirements should be noted:

MILK, FRESH

To be the whole normal lacteal secretion obtained from healthy, properly fed cows, the milking and subsequent handling of the milk to be carried out by healthy persons under clean, sanitary conditions. Milk produced within thirty days before calving or seven days after calving or that containing abnormal amount of colostrum to be discarded. The milk to contain not less than 3.4 per cent butter fat and no added water or preservative. To be held at a sufficiently low temperature to insure keeping for not less than twenty-four hours.

CREAM, FRESH

To be separated from clean, whole normal milk obtained from healthy, properly fed cows, excluding that drawn within thirty days before calving or seven days after calving or that containing an abnormal quantity of colostrum. The separation to produce a cream containing not less than 20 per cent of butter fat. To be handled by healthy persons in a clean, sanitary manner and held at a sufficiently low temperature to insure keeping for at least twenty-four hours.

CHAPTER XVIII

Products Inspection (continued)

L. ICE CREAM

1. General. Ice cream includes a large variety of frozen products containing cream, sugar, flavoring substances and other ingredients, frozen under agitation.

The National pure food law defines and classifies ice creams as follows:

Ice cream is a frozen product made from cream and sugar, with or without a natural flavoring, and contains not less than fourteen (14) per cent of milk fat.

Fruit ice cream is a frozen product made from cream, sugar, and sound, clean, mature fruits, and contains not less than twelve (12) per cent of milk fat.

Nut ice cream is a frozen product made from cream, sugar, and sound, non-rancid nuts, and contains not less than twelve (12) per cent of milk fat.

In Iowa Experiment Station Bulletin 123, May, 1911, Professor Mortensen classifies ice creams as follows:

1. Plain ice cream is a frozen product made from cream and sugar, with or without a natural flavoring.
2. Nut ice cream is a frozen product made from cream and sugar and sound, non-rancid nuts.
3. Fruit ice cream is a frozen product made from cream, sugar, and sound, clean, mature fruits.
4. Bisque ice cream is a frozen product made from cream, sugar and bread products, marshmallows or other confections, with or without other natural flavoring.
5. Parfait is a frozen product made from cream, sugar and egg yolks, with or without nuts, fruits and other flavoring.
6. Mousse is a frozen whipped cream to which sugar and natural flavoring have been added.
7. Pudding is a product made from cream or milk, with sugar, eggs, nuts and fruits, highly flavored.
8. Aufait is a brick cream consisting of layers of one or more kinds of cream, with solid layers of frozen fruits.
9. Lacto is a product manufactured from skimmed or whole sour milk, eggs and sugar, with or without natural flavoring.
10. Ices are frozen products made from water or sweet skimmed or whole milk and sugar, with or without eggs, fruit juices or other natural flavoring.

Ices may for convenience be divided into sherbets, milk sherbets, frappés, punches and soufflés.

A sherbet is an ice made from water, sugar, egg albumen, and natural flavoring, and frozen to the consistency of ice cream.

Milk sherbet is an ice made from sweet skimmed or whole milk, with egg albumen, sugar and natural flavoring, frozen to the consistency of ice cream.

Frappé is an ice consisting of water, sugar and natural flavoring and frozen to a soft, semi-frozen consistency. The same formulas as are given for sherbets will answer for frappé by omitting the egg albumen.

Punch is a sherbet flavored with liquors or highly flavored with fruit juices and spice.

Soufflé is an ice made from water, eggs, sugar and flavoring material. It differs from sherbets mainly in that it contains the whole egg.

Another classification dealing with ice cream and ices as given by C. Larsen and Wm. White is as follows:

1. Philadelphia Ice Cream.

Made up of cream, sugar, flavoring, and usually a binder. Under this heading the following would be included: Plain ice cream, nut ice cream, fruit ice cream, chocolate ice cream, coffee ice cream, macaroon ice cream, etc.

2. Neapolitan Ice Cream.

This differs from the first class chiefly in that it always contains eggs. This kind of ice cream admits of wide varieties and may resemble in composition and consistency a frozen pudding more than an ice cream.

3. Fancy Ice Cream.

This kind of ice cream differs chiefly from the Philadelphia Ice Cream in the manner of molding or printing, and in the coloring.

Brick Ice Cream.

This is usually made up in pint, quart, and two-quart sizes. It is made in layers. Any of the ice creams may be used for this purpose.

Individual Molds.

These molds are shaped to imitate some object (fruit or animal). The ice cream object may be colored in imitation of the object it represents. Associated with ice cream are numerous other ices, none of which, however, are dairy products. These are usually considered under the following heads:

4. Ices.

Water ice is fruit juice diluted with water to the proper degree, sweetened and frozen the same as is ice cream. Its texture is quite different from that of ice cream. The latter is smooth and velvety, while the former is grainy, being more like firm, wet snow in texture.

Sherbet sometimes closely resembles ice cream in appearance, body, and texture. However, no cream or milk is used in this ice. Its creamy appearance is due to the presence of beaten white of egg, gelatin, or other binders. Sherbet is composed of fruit juice, water, sugar, white of egg, and, sometimes, a binder. If beaten violently until frozen hard the result will be a fine, smooth, creamy ice. If frozen with but slight agitation or only half frozen, the result will be a more granular texture.

Sorbet is a name sometimes applied to sherbets of fine, smooth texture.

Granites are water ices only half frozen without much stirring, have a coarse icy texture.

Frozen Punches are made by adding one or more liquors or cordials like champagne, maraschino, Jamaica rum, etc., usually after the freezing is nearly or entirely completed.

2. *Commercial Production. a. Ingredients Used.* (1 Cream and Milk. The cream and milk used in the manufacture of ice cream should be derived from healthy cows and produced, cooled, handled and stored under strict sanitary conditions. When received at the factory, cream or milk should be cold and fresh, with a clean, pleasant odor and flavor. The acidity should not exceed 0.25 per cent. It is desirable that the cream contain 22 to 25 per cent of fat. Ice cream made from cream with less than 22 per cent of fat may have a "lean" flavor. Cream may be homogenized at 140 to 180°F. to increase its viscosity. Pasteurization when employed largely destroys the viscosity of cream which is necessary to obtain the "swell" during freezing. This may be overcome and the viscosity increased by holding the cream at a low temperature for twelve to twenty-four hours.

(2) Flavoring Materials. In addition to the cream content which influences the flavor of the ice cream, there may be added sweetening and other flavoring agents as extracts, crushed fruits, fruit juices, nuts, spices, sugars, syrups and sometimes a small amount of salt. Artificial or synthetic flavors may be used if in compliance with Federal and State laws. About 14 per cent of sugar in the finished product is desirable. Sugar materially depresses the freezing point of ice cream mixtures. Only sound, approved flavoring ingredients of good grade should be used.

(3) Stabilizers. Stabilizers, also called "binders," "fillers" and "colloids," are substances added to an ice cream mixture to improve the body and texture of the ice cream and to prevent the formation of ice crystals. "Body" refers to the structure or substance of the entire mass of ice cream as a unit, while texture refers to the arrangement of the particles in its make up. Stablizers include eggs, unsweetened condensed milk, milk powder, gelatin, gum tragacanth, rennet, wheat flour, rice flour, arrow starch and corn starch.

Eggs are used to insure stability of texture and to enhance the flavor of ice cream. Mixtures containing eggs usually are well cooked before using. Eggs slightly depress the freezing point of the mixture. Gelatin of good quality dissolved in hot water or skim milk, is used

as a stablizer especially to prevent the formation of ice crystals. Usually 4 ounces are used to 10 gallons of mixture. Too large an amount of gelatin will produce a spongy, sticky and stiff ice cream. Gelatin of poor quality, usually has a dangerous germ content and impairs the flavor of ice cream. One ounce of gum tragacanth dissolved in 1 quart of hot water is sufficient to "stabilize" 10 gallons of ice cream. It is odorless and tasteless. Starchy stabilizers are well cooked otherwise a granular texture is imparted to the ice cream.

b. Manufacture. After the proper preparation of the various ingredients and their combination, the ice cream mixture may or may not be pasteurized, homogenized, cooled, "aged" to increase the yield and to improve the quality of the body and texture of the finished product, then frozen under agitation by means of a salt and ice mixture or by refrigerated brine, transferred to chilled packing cans or fancy molds, and the hardening completed without agitation. During freezing, agitation is necessary to prevent ingredients with different freezing points from separating out. Agitation also incorporates air into the mixture so that the finished product swells or increases in bulk and occupies a larger space than the original mixture. This "swell" or "overrun" may vary from 50 to 100 per cent and produces a light, soft product. Some manufacturers use carbon dioxide in this connection, claiming a light, fluffy, velvety product with inhibition of microbial activity. The "swell" commences at 34°F., its maximum is reached at 28.5°F. and ceases at 27°F.

Rapid freezing produces crystallization while slow freezing with violent agitation produces a firm-bodied, smooth-textured ice cream free from crystals.

Freezing is stopped at 27 to 28°F. when the ice cream has a consistency of evaporated milk. It then is transferred into cans or fancy molds and packed in a salt and ice mixture, set into a refrigerated brine tank, or placed into a refrigerated hardening room, to freeze. Hardening is continued until the temperature has been reduced to from 17 to 14°F.

Ice cream which has become softened should not be refrozen as it may contain poisonous products of bacterial growth or enormous quantities of microörganisms sufficient to make the product unsafe.

A recent method of manufacturing ice cream consists of spraying a homogenized ice cream mixture through an atomizer into a hardening room lined with shiny steel and maintained at a desired low temperature. Minute snowflake-like frozen particles collect at the bottom in softened form and are drawn off by means of a "worm."

One manufacturer cans and sterilizes ice cream mixtures for home purposes.

3. Army Requirements. a. Sanitary. The inspection of ice cream factories furnishing ice cream for troops, according to Army Regulations devolves upon the sanitary service of a station. The steps involved in the sanitary examination of ice cream intended for troops, begin with a consideration of its sanitary source, and include organoleptic and Medical Department laboratory examinations for purity and soundness of all ingredients used; the sanitary supervision of all methods employed in its production, packing, hardening or other manipulation, handling, storage, receipt and issue with such re-inspections as are required. It also includes the sanitary location, construction, equipment, personnel and methods of operation of establishments involved, as defined by Army Regulations (See Chapter III, Handbook).

All ingredients used in the manufacture of ice cream intended for troops should comply with the sanitary requirements of the Surgeon General. This includes proper sanitary examinations of dairy farms, or other establishments furnishing raw milk and cream as outlined in Chapter XVII. Also reference may be made to Chapters VII, XIII, XV, XIX and XX regarding other authorized ingredients and those of animal origin to be used in the manufacture of ice cream for troops.

Raw milk and cream although produced under the best of conditions may become contaminated or contain disease germs due to improper handling and preparation. Infected or highly contaminated products when made into ice cream become dangerous to health. The bacterium which causes typhoid fever may live in ice cream for thirty-nine days. As a precautionary measure all ingredients to be used in the production of ice cream should be heated properly to inactivate or destroy all pathogenic organisms. All machinery, utensils and containers or other apparatus coming into contact with the product in any manner should be clean and sterile. This includes the homogenizers, coolers, holding vats, freezers, containers, moulds, and other equipment.

Commercially, samples of ice cream may contain from 130,000 to 365,000,000 bacteria per cubic centimeter. Metallic compounds formed in milk or cream transported in rusty or improperly tinned containers, and products of bacterial growth in old or softened ice cream, may be dangerous to health. Samples of ice cream for Medical Department Laboratory examination should be representative. Small portions of a container or carton samples may be misleading.

b. Purchase. One War Department purchase specification under date of May 10, 1919 in part is quoted as follows, however current purchase requirements should be noted:

Ice Cream

To be freshly made from fresh clean milk and the usual ingredients; to be prepared under sanitary conditions and to conform to the standards adopted by the United States Deparment of Agriculture. No refrozen ice cream will be considered.

In the physical examination of ice cream, score cards may be used.

University of Nebraska's Score Card

	points
Flavor	45
Body	20
Texture	20
Appearance	10
Package	5
Perfect Score	100

Mortensen's score card as given in Iowa Experiment Station Bulletin No. 123, is given below:

Flavor	45
Texture	25
Richness	15
Appearance	10
Color	5
Total	100

I. FLAVOR

Definition of Good Ice Cream Flavor

The cream flavor must be clean and creamy, and combined with flavoring material which blends with the cream to a full and delicious flavor.

Defects in Flavor

1. Defects due to the use of flavors which will not blend with the other ingredients.
2. Defects due to cream used:
   - Sour cream flavor
   - Old cream flavor
   - Bitter cream flavor
   - Metallic cream flavor
   - Oily cream flavor
   - Weedy cream flavor
   - Barn flavor

Unclean flavor
Burned or overheated flavor

3. Defects in flavor due to filler used:
   Condensed milk flavor
   Starch flavor
   Gum flavor
   Gelatin flavor
4. Defects in flavor due to other ingredients:
   Too sweet
   Lack of sweetness
   Course flavor due to flavoring material
   Stale fruit flavor
   Rancid nut flavor
   Moldy nut flavor

II. TEXTURE

Definition of Good Texture

The cream must be firmly frozen and be smooth and velvety.

Defects in Texture

Icy. This defect is most noticeable toward the bottom of the container and may be due to improper packing or by holding too long, ice cream which was manufactured without filler.

Coarse. This defect may be due to the use of too thin cream, or to packing while too soft.

Sticky. This is due to fillers such as gelatin, sweetened condensed milk, glucose, etc.

Buttery. This defect is due to the use of cream which has been partially churned before freezing, or to cream which enters the freezer at too high a temperature. It may also be due to operating the freezer at too high speed or to some defect in the construction of the freezer.

Too Soft. Due to improper packing after freezing.

When judging cream containing nuts, fruits, etc., due allowance should be given for the presence of such ingredients.

III. RICHNESS

Ice cream containing the amount of butter fat required by the State pure food law should be considered perfect in richness.

The richness is determined by making chemical analysis for fat.

IV. APPEARANCE

Ice cream scoring perfect in appearance should be clean and neatly put up, and in a clean container.

Defects: Cream of unclean appearance; Lack of parchment circle over ice cream; dirty container; rusty container; dirty ice cream tub; old tag strings attached to handle of tub.

When judging brick ice cream special attention should be given to the uniformity of the layers, to the neat folding of the parchment wrapper, and to cleanliness and general appearance of the package.

V. COLOR

Ice cream of perfect color is such as contains only the natural color imparted to it by the flavoring material used. If color is added it should harmonize with the particular flavoring used.

Defects in Color: Too high color; unnatural color such as colors different from the color of the natural flavoring material used.

Individual molds, if colored, should be as nearly as possible the same color as the object they represent.

Washburn's score card as given in Vermont Experiment Station Bulletin 155, is as follows:

Flavor	45
Body	20
Texture	20
Permanency	10
Package	5
Total	100

Flavor: To be that of clean, sweet cream sweetened to taste with cane sugar; the score to be cut for any flavor of sour cream, and cut severely for any dirty flavor, and but little if too sweet or not sweet enough, or if the added flavor is too high or low, for these are largely regulated by trade demands.

Body: To be firm, mellow and slightly elastic under pressure of the finger at a temperature of 18°F. or less. It must not be rubbery or too weak.

Texture: To be smooth, creamy, and free from coarse water crystals; the score to be cut moderately if too coarse, and severely if inclined to be sticky or doughy.

Permanency: To have a reasonable standing-up power on an ordinary cool dish, and to offer some resistance in the mouth instead of melting and disappearing as liquid almost immediately upon being tasted.

Package: To be clean, tidy, and free from evidence of slovenly workmanship.

CHAPTER XIX

Products Inspection (continued)

M. CONDENSED MILK

1. General Consideration. Condensed milk is fresh cows' milk from which a considerable quantity of the water has been removed by evaporation and to which sucrose may or may not have been added.

The following standards of condensed, evaporated, concentrated milk were adopted by the United States Department of Agriculture June 21, 1922, and became effective January 19, 1922, as per Food Inspection Decision 189:

> Condensed Milk, Evaporated Milk, Concentrated Milk, is the product resulting from the evaporation of a considerable portion of the water from milk, or from milk with adjustment, if necessary, of the ratio of fat to non-fat solids by the addition or by the abstraction of cream. It contains, all tolerances being allowed for, not less than seven and eight-tenths per cent (7.8 per cent) of milk fat, nor less than twenty-five and five tenths per cent (25.5 per cent) of total milk solids; provided, however, that the sum of the percentages of milk fat and total milk solids be not less than thirty-three and seven-tenths (33.7).

The Federal definition and standard for condensed skim milk under Food Inspection Decision 170, March 31, 1917, follow:

> Condensed skimmed milk, evaporated skimmed milk, concentrated skimmed milk, is the product resulting from the evaporation of a considerable portion of the water from skimmed milk, and contains, all tolerances being allowed for, not less than twenty per cent (20.0 per cent) of milk solids.

a. Sweetened Condensed Milk. Sweetened condensed milk is cows' milk condensed at a ratio of $2\frac{1}{2}$ to $2\frac{3}{4}$ parts of fresh milk to 1 part of condensed milk. Usually it contains about 40 per cent of sucrose. It is of semi-fluid consistency with a specific gravity of 1.28 to 1.30. It is placed into hermetically sealed cans holding 8 ounces to 1 gallon or into barrels, similar to glucose barrels of 300 to 700 pounds net capacity. It is best when fresh. When properly prepared and stored it will keep several months.

The Federal definitions and standards for sweetened condensed milk under Food Inspection Decision 170, March 31, 1917, follow:

Sweetened condensed milk, sweetened evaporated milk, sweetened concentrated milk, is the product resulting from the evaporation of a considerable portion of the water from the whole, fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and ten days after calving, to which sugar (sucrose) has been added. It contains, all tolerances being allowed for, not less than twenty-eight per cent (28.0 per cent) of total milk solids, and not less than eight per cent (8.0 per cent) of milk fat.

Sweetened condensed skimmed milk, sweetened evaporated skimmed milk, sweetened concentrated skimmed milk, is the product resulting from the evaporation of a considerable portion of the water from skimmed milk to which sugar (sucrose) has been added. It contains, all tolerances being allowed for, not less than twenty-eight per cent (28.0 per cent) of milk solids.

b. Unsweetened Condensed Milk. Unsweetened condensed milk includes concentrated, plain condensed bulk and evaporated milk, and evaporated cream.

(1) Concentrated Milk. Concentrated milk is whole, or partly or wholly skimmed, cows' milk, condensed in open vats by means of currents of hot air, so that one part of the finished product represents 3 to 4 parts of the fresh milk. It is not sterile. It is sold in pint or quart bottles for immediate consumption. Its keeping qualities are similar to those of a high grade pasteurized milk.

(2) Plain Condensed Bulk Milk. Plain condensed bulk milk is unsweetened condensed milk made from whole milk or partly or wholly skimmed milk condensed in vacuo at the ratio of about 3 or 4 parts of fresh milk to one part of condensed milk. Usually, it is superheated to swell and thicken it. It is not preserved with sucrose and is not sterile. It has a consistency of rich cream. It is sold in 10 gallon milk cans to ice-cream and other factories, and in milk bottles direct to the consumer. Its keeping qualities are similar to pasteurized milk of high quality. When properly prepared, it has been kept at a low temperature as long as ten days.

(3) Evaporated Milk and Cream. (a) Evaporated Milk. Evaporated milk is cows' milk which has been condensed in vacuo at a ratio of about $2\frac{1}{2}$ parts of fresh milk to one part of condensed milk, placed into hermetically sealed tins holding $6\frac{1}{2}$ ounces to 1 gallon and sterilized in steam under pressure. It has a consistency of thin cream and when properly made will keep indefinitely. The average composition of evaporated milk is water 73 per cent and milk solids 27 per cent. These solids include ash 1.5 per cent, fat 8.3 per cent, lactose 9.7 per cent and proteids 7.5 per cent.

Upon receipt of fresh milk at a factory it is inspected as to odor and temperature. Samples are taken and tested for specific gravity, relation of fat to other solids, and acidity. Milk containing 0.18 per cent or more of lactic acid is not desirable for condensing purposes. Sediment, boiling and fermentation tests also may be made. Only suitable milk of high quality should be condensed. Until used the milk may be kept at 40 to 45°F. The milk may be heated, clarified and run into a vacuum pan maintained at 24 to 28 inches of vacuum. Under these conditions the milk will boil at 105 to 135°F. The milk is condensed until a sample drawn shows a desired degree of concentration on a Beaumé hydrometer. Usually this is equivalent to a specific gravity of 1.05 to 1.075 at 60°F.

The hot condensed milk is run through a homogenizer to prevent fat separation, quickly cooled, and stored at a low temperature in sanitary holding tanks under slow agitation. It is now standardized to meet Federal or other requirements and a viscosity test made. It then is canned, the cans inspected for leaks, then sterilized. The temperatures employed, length of time and methods used in sterilizing evaporated milk, vary. Usually temperatures between 226 and 245°F. are used.

After sterilization, the canned milk is placed into a shaking apparatus to break up lumps of fat or curds that have formed and to produce a smooth and homogeneous product.

The cans may be marked and placed into an incubating room; or, labeled, packed in cases and an aliquot sample of cans incubated.

Incubation is conducted on an entire batch, or representative samples, for ten to thirty days at 70 to 90°F. to develop defects, including souring, curdling, solidification and gaseous conditions. Before packing, all cans coming from the incubating room are inspected individually and shaken by hand. All cans showing bulges or which do not shake with the characteristic behavior and sound of a liquid, are rejected. The sound cans are labeled by hand or machine then packed in cases. One gallon cans are packed 6 to a case, 14 to 20 ounce cans 48 to a case, and 8 ounce cans 72 to 96 per case. The cases are marked with the batch number and other data.

Evaporated milk should be stored at temperatures below 60°F. and above freezing and the cases occasionally turned. This in a measure will offset the tendency of the fat to separate out or the milk to solidify. Long storage is undesirable as the acid content of the milk may react on the metal of the container producing off flavors, solidification or swells due to hydrogen gas.

(b) Evaporated Cream. Cream may be prepared similarly to unsweetened evaporated milk.

2. Army Requirements. The veterinary examinations of condensed milks intended for troops begin with a consideration of the sanitary source of the fresh milk used; include sanitary dairy farm inspections as described in Chapter XVII, the sanitary handling of the milk between dairy farms and the factory; and the supervision of the sanitary requirements relating to inspection of the milk or cream upon receipt at condensing plant, sampling, storage, heating, condensing and the homogenizing, cooling, storage, standardization, canning, sterilization, shaking, incubation, testing, labeling, packing or other manipulation, handling, storage, shipment, receipt and issue of the condensed product; with such reinspections as are required.

The selection and grading of sucrose used in sweetened condensed milk also are considered (See Chapter IX, part 1). A veterinary, sanitary examination should be given the location, construction, equipment and methods of operation of establishments involved as defined by Army Regulations (See Chapter III, Handbook). Veterinarians should be familiar with the National and state pure food laws regarding standards, authorized ingredients and labeling. Purchase specifications also should be consulted.

a. Inspections prior to Purchase. The veterinary inspections of condensed milk prior to purchase are the examinations made during manufacture or when the product is offered for sale to the Government at purchasing points or in the field, and include an examination for sanitation and soundness. In any event the inspecting veterinary or medical officer should be informed a sufficient length of time in advance when and where products are to be prepared and every facility and opportunity should be furnished the veterinarian for the proper inspection of all products. In the event it is necessary to purchase the finished product the sanitary production should be indicated by the standard markings on the containers or a suitable certificate of a recognized, official and competent sanitary inspection agency. A further sanitary organoleptic re-inspection of the finished product is required, to be supplemented when deemed necessary by Medical Department laboratory examinations in accordance with Army Regulations.

(1) Sanitation. The general sanitary requirements for dairy farm inspection also for condensed milk factories, are discussed in Chapter XVII and III respectively.

(2) Milk. Milk to be condensed for the use of troops should meet all the sanitary requirements of the Surgeon General, including health of dairy animals and veterinary dairy farm inspection as defined in Army Regulations (See Chapter XVII, Handbook) and the handling of the milk from the time it leaves the hands of the dairyman, throughout all steps of manufacture, packing, storage, shipment, receipt and issue.

Milk from diseased cattle, cattle in poor condition; from cows thirty days prior to and twelve days after parturition; from insanitary dairy farms or where careless methods are employed; and when improperly cooled, unclean, polluted, tainted, fermented, soured, possessing an off odor, or otherwise unsound; warm; of too great an acidity or not complying with standards relative to butter fat and other solids; should be rejected.

(3) Preparation. All methods of manufacture should be given a strict sanitary veterinary examination, and should be sufficient to produce a smooth, homogeneous product of characteristic flavor, odor and consistency and complying with all sanitary and other standards. Cans should be inspected for cleanliness and freedom from defects. (See Chapter X, "Canned Meats.") Water used for cleaning purposes should be pure and wholesome. Incubation should be sufficient as to exclude all defective cans. Labeling, packing and markings on cases should meet all requirements.

Two War Department specifications, under date of May 10, 1919 are quoted in part as follows, however in each instance the current purchase requirements should be consulted.

Milk, Evaporated, Unsweetened

To be whole, fresh milk obtained from healthy cows, evaporated to have a consistency with total solids not less than 25.5 per cent of total solids, and not less than 7.8 per cent of milk fat. To be processed to have a smooth uniform body, and to be free from scorched or overcooked flavor. It shall conform to the standards of the United States Department of Agriculture.

Milk, Condensed, Sweetened

To be prepared by the evaporation of a considerable part of the water from whole, clean, fresh milk from healthy cows, to which sugar (sucrose) has been added. To contain not less than 28 per cent of total milk solids and not less than 8 per cent of milk fat. It shall conform to the standards of purity established by the United States Department of Agriculture.

(4) Inspection of the Finished Product. The general and external examination of canned condensed milk or cream for purchase should

be along the same lines as described in Chapter X, for canned meats. When deemed necessary or when required, selected samples should be opened by the veterinarian for examination or sent to a Medical Department Laboratory in compliance with Army Regulations.

Defects of sweetened condensed milk include, gaseous fermentation due to yeasts or to impure sugar; a brown color due to caramelizing, storage in a warm place or to age; a metallic flavor due to copper salts from an insanitary copper vacuum-pan dome; a rancid flavor or odor due to bacteria, a stale or putrid flavor or odor due to enzymes, bacteria or long storage; settling of sucrose to the bottom of a container; gritty, sandy or rough consistency due to precipitation of lactose; a thickened, cheesy or solid consistency with a stale, disagreeable, cheesy flavor due to the feed of the cows, colostrum, acid, superheating, long storage, storage at warm temperatures or bacteria; and a lumpy, cheesy consistency on the seams, throughout, or floating on the surface in the form of white, yellow, brown or red "buttons" due especially to the activity of molds, or to acid flux.

Defects of unsweetened condensed milk include gaseous fermentation due to improper sterilization or leaky cans; a puffed or blown condition due to freezing, chemical action or a great change of temperature or altitude; a brown color due to caramelization of lactose by overprocessing; a metallic flavor as described above; a fish flavor and odor due to certain bacteria; a white, solid, coagulated condition with a bitter flavor due to bacteria; a curdy or lumpy condition with precipitation of casein due to milk of poor quality, to excessive heat or too great a concentration; a white, grainy or granular sediment due to precipitation of mineral matter rendered insoluble by heat; and separation and churning of fat due to insufficient homogenizing, long storage or to transportation of old stocks.

Other defects generally consist of dilutions, substitutions or other adulterations, short weight, improper labeling and non-compliance with required standards.

b. *Inspections on Receipt, during Storage and at Issue.* These are conducted much the same as described for canned meats, Chapter X.

c. *Action.* This in general is the same as described for canned meats, Chapter X.

CHAPTER XX

Products Inspection (continued)

N. POWDERED MILK

1. Commercial Production and Storage. Whole milk, partly or wholly skimmed milk, or cream, from cows may be dried to form desiccated, dried, dehydrated or dry milk also known as milk flour or milk powder and cream powder. Three general methods have been used in the desiccation of milk and cream, the dough, film and spray drying processes.

a. Dough Drying. Dough drying consists of condensing milk in open vats or pans or in vacuo, usually accompanied with agitation, to a dough-like consistency; spreading the concentrated mass on trays and drying it in heated rooms, in currents of heated air or in vacuo; and grinding the dried product to a fine powder. Sometimes sugar, and an alkali as carbonate of soda or potash have been added to render the casein more soluble.

b. Film Drying. In film drying, milk or concentrated milk is dried in the open air or in vacuo, in a film on steam heated rolls and the dried product reduced to a fine powder.

c. Spray Drying. In spray drying processes, milk, or milk whose density has been increased by a suitable thickener such as desiccated or condensed milk, or by pre-condensing, is atomized in a fine spray over a current of heated air in an enclosed chamber, the small, finely divided droplets of milk quickly surrendering their moisture through evaporation. The change of state immediately cools the fine dry particles of milk, which fall to the bottom of the drying chamber. The moisture is removed from the chamber by appropriate means, and measures are taken to recover the extremely fine milk dust escaping from the drying chamber with the expelled air.

d. Packing. Dough and film-dried milks are ground, while the floury, spray-dried milk is sifted; then packed in tin or fibre containers or in paper-lined barrels similar to sugar barrels. Sifting and packing should be conducted after the milk powder is thoroughly cooled, otherwise the product has a tendency to lump up due to the soft condition

of the fat. Packages should be of tight construction to prevent insect or other vermin infestation, and to exclude air and light.

e. Storage. Cream and whole milk powders tend to become rancid more quickly than skim milk powder. Due to contained metal or metallic salts, especially of copper, a metallic flavor may develop during storage. Due to long storage, heat, air or light, stale or rancid flavors may develop. Cold dry storage is desirable. Excessive moisture in milk or cream powders may result in bacterial or mold growth with a development of undesirable flavors and lumps. Since desiccated milks are hygroscopic they should be kept in tight containers.

f. Composition. The chemical composition of desiccated milk and cream varies considerable. Whole milk powder averages 26 to 29 per cent fat, skim milk powder may contain 1 per cent fat and over 95 per cent S.N.F., while cream powders may contain as much as 70 per cent of fat and less than 30 per cent S.N.F. The moisture in the sprayed product varies from 0.5 to 3.5 per cent with an average of 2 per cent while film dried milk may contain 3 to 6 per cent. It is stated that in milk powder containing less than 3 per cent of moisture bacterial growth is discontinued.

According to Larsen and White, the composition of desiccated milks is as follows:

INGREDIENT	WHOLE MILK	HALF-SKIMMED MILK	SKIMMED MILK
	per cent	*per cent*	*per cent*
Casein	26.92	33.30	37.00
Milk sugar	36.48	39.70	47.00
Butter fat	29.20	15.10	1.00
Milk salts (ash)	6.00	6.90	8.00
Moisture	1.40	5.00	7.00

COMPOSITION OF MILK AND CREAM POWDERS
(*Merrell-Soule*)

	BUTTER-FAT	CASEIN	ALBUMIN	MILK SUGAR	ASH	MOISTURE
Skimmed milk	1.35	29.79	7.91	49.94	8.21	2.40
Half skimmed	14.20	25.56	6.70	44.41	7.01	2.12
Whole milk	28.20	21.22	5.45	47.88	5.75	1.50
15 per cent cream	65.15	10.60	2.82	17.86	2.91	0.66
18 per cent cream	70.47	9.08	2.42	15.01	2.46	0.56

According to Federal Pure Food Decision 170, March 31, 1917, dried milk is defined as follows:

Dried milk is the product resulting from the removal of water from milk, and contains, all tolerances being allowed for, not less than 26 per cent of milk fat, and not more than 5 per cent of moisture.

Dried skimmed milk is the product resulting from the removal of water from skimmed milk and contains, all tolerances being allowed for, not more than 5 per cent of moisture.

2. Reconstruction. Skim milk for bakers' use also whole milk or cream, may be produced from milk or cream powders. In reconstitution or reconstruction of whole milk or cream the composition as well as the number of bacteria can be controlled within certain limits. Skim milk, whole milk or cream powders may be mixed with water without using any special mixing machinery.

Fluid whole milk may be reproduced from skim milk powder, sweet (unsalted) butter and pure water by mixing and heating proper amounts of the ingredients in a vat under agitation, so as to pasteurize the mixture thirty minutes at 145°F. The product then is run through an emulsifier, and immediately cooled. The process serves to aerate the reconstructed milk. The finished product if properly produced under strict sanitary conditions should have a low bacterial count of about 2000 per cubic centimeter and should simulate fresh, cows' milk in appearance, consistency, flavor and odor. Creaming may be retarded.

Properly reconstructed milk may be useful when a supply of pure fresh milk is not available, where it is not desirable to maintain a dairy herd, for sick and wounded in transit or where a liquid or special diet is required.

3. Army Requirements. The veterinary examinations of desiccated milk or cream intended for troops begin with a consideration of the sanitary source of the fresh milk used; include sanitary dairy farm inspection as described in Chapter XVII, the sanitary handling of the milk between dairy farms and the factory, and the supervision of the sanitary requirements relating to inspection of the milk or cream on receipt at the powdered milk plant, its sampling, storage, manufacture into powdered milk, packing or other manipulation, handling, storage, shipment, receipt and issue of the finished product, with such reinspections as are required. A veterinary sanitary examination should be given the location, construction, equipment and methods of operation of establishments involved as defined by Army Regulations (See Chapter

III, Handbook). Veterinarians should be familiar with the National and State pure food laws regarding standards, authorized ingredients and labeling. Purchase specifications also should be consulted.

The veterinary inspections of powdered milk prior to purchase insofar as applicable simulate those described in Chapter XIX, "Condensed Milk."

Two War Department specifications under date of May 10, 1919, are quoted in part as follows, however, in each instance the current purchase requirements should be consulted:

MILK, POWDER, WHOLE

To be prepared from clean, whole, fresh milk obtained from healthy cows properly fed and kept. The evaporation to be conducted in such a manner that the resultant product will contain not less than 26 per cent of milk fat and not more than 5 per cent moisture. The powder to have the normal odor of such a product, to be free from rancidity, and when properly mixed with water in the same ratio as given off in evaporation it will yield a product approximating fresh milk. It shall conform to the existing standards of purity established by the United States Department of Agriculture.

MILK, POWDER, SKIM

To conform to the same specifications as for dried whole milk except for fat. Shall not contain more than 5 per cent moisture. Upon properly combining the necessary proportion of butter fat and water it shall yield a product approximating fresh skimmed milk.

Inspections on receipt, during storage and at issue with action in general are the same as described for fresh meats, Chapter VIII.

The inspection of reconstructed milk intended for troops, and its production, devolves upon the sanitary service of a station. The steps involved in its sanitary examination begin with a consideration of its sanitary source, and include organoleptic and Medical Department laboratory examinations of ingredients used and of the finished product; the sanitary supervision of the manufacturing establishment, methods employed, personnel, and the handling, storage, receipt and issue, with such reinspections as are required. In the inspection of sweet butter used in the manufacture of reconstructed products, reference may be made to Chapter XXII.

CHAPTER XXI

Products Inspection (continued)

O. MALTED MILK

1. Commercial Production. Malted milk is a product resulting from the combination of an extract of malted barley and wheat flour with whole milk, and the mixture desiccated in vacuo to dry form.

Grains as barley, rye, oats and others may be steeped in tubs of water until germination starts, spread on floors in a thick layer, turned each day and allowed to sprout, to develop diastase. After sprouting, the grain is kiln-dried and screened to remove the sprouts. It is stated that malted grain contains about 1/800 part of diastase, one part of which is capable of transforming 2000 parts of starch into dextrin, then into fermentable sugar.

In the manufacture of malted milk, a mash is prepared by combining wheat flour, a barley malt of high diastatic quality and water. This mixture is heated to a certain desirable temperature a sufficient length of time to insure the complete transformation of the insoluble starch into dextrin and dextrose. After conversion, the malted grain is removed from the fluid portion. The latter is combined with whole milk and reduced to a dry form in a vacuum pan under agitation, on a heated revolving roll in vacuum, or by other methods. The temperature employed in vacuo may be sufficient to pasteurize the malted milk yet preserve its digestibility. Sodium or potassium bicarbonate and sodium chloride sometimes are used in the manufacture of malted milk.

The dried product is ground and filled into glass or tin containers and sealed air tight. Flavors may be combined with malted milk and the product made into tablet or cake form.

Under proper storage conditions, malted milk will keep indefinitely. This in part is due to the finely divided fat globules, being enclosed in a coating of sugars, gluten, and salts sufficiently to protect them against the deteriorative action of air. Malted milk in storage should be protected against high temperatures and vermin.

According to Federal Food Inspection Decision 170, March 31, 1917. malted milk is defined as follows:

Malted milk is the product made by combining whole milk with the liquid separated from a mash of ground barley malt and wheat flour, with or without the addition of sodium chloride, sodium bicarbonate, and potassium bicarbonate in such a manner as to secure the full enzymic action of the malt extract and by removing water. The resulting product contains not less than $7\frac{1}{2}$ per cent of butter fat and not more than $3\frac{1}{2}$ per cent of moisture.

2. *Army Requirements.* The veterinary examinations of malted milk intended for troops are along the same general lines as discussed for powdered milk in Chapter XX. The current purchasing requirements also should be noted. The quality requirements of malted milk described in one War Department specification of May 10, 1919 are almost identical with those as quoted above under the Federal pure food requirements.

CHAPTER XXII

PRODUCTS INSPECTION (CONTINUED)

P. BUTTER

1. General Considerations. a. Butter, Defined. Butter is the fatty constituent of whole milk, sweet or sour cream, or whey from which the greater part of the milk plasma has been separated by churning or other preparation. It is a mixture of milk fat with small amounts of cream, curd, lactose, acid, ash, water and vitamines and may contain salt and authorized coloring matter.

According to Federal Food Inspection Decision 190, January 19, 1923, butter is defined as follows:

> Butter is the clean, sound, product made by gathering in any manner the fat of fresh or ripened milk or cream into a mass, which also includes a small portion of the other natural milk constituents, with or without salt, and contains, all tolerances provided for, less than sixteen per cent (16.0 per cent) of water, and not less than eighty per cent (80.0 per cent) of milk fat. By acts of Congress, approved August 2, 1886, and May 9, 1902, butter may also contain added coloring matter.

APPROXIMATE AVERAGE COMPOSITION OF BUTTER
(*Hunziker*)

	SALTED BUTTER	UNSALTED BUTTER
	per cent	*per cent*
Butterfat	82.5	84.0
Water	13.8	14.5
Salt	2.5	0.0
Curd	0.6	0.85
Ash	0.1	0.20
Lactose	0.25	0.3
Acid	0.15	0.15
Total	100.00	100.00

b. Classification. Various classifications of butter and definitions of classes exist in different localities.

Under date of May 28, 1919 the United States Bureau of Markets gives the following classification and definition of classes of butter:

Butter shall be considered as comprising the following classes: Dairy butter, Creamery butter, Packing stock butter, Ladled butter, Process or renovated butter and Grease butter.

Dairy butter is made on a farm. Creamery butter is butter made in a creamery or factory. Packing stock butter is dairy butter or other butter in its original form in miscellaneous lots of such wholesomeness that it may be used in making ladled or process butter. Ladled butter is the product made by reworking miscellaneous lots of dairy butter or other butter or both. Process or renovated butter is the product made by melting, refining and churning, or reworking packing stock or other butter or both. Grease butter is any butter which is unwholesome or otherwise unfit for use for ladling or renovating.

Under date of April, 1921, the National Poultry, Butter and Egg Association classifies and defines the classes of butter as follows:

Butter shall be classified as Creamery, Centralized Creamery, Held Butter, Renovated, Ladles and Packing Stock.

DEFINITIONS

Creamery. Butter offered under this classification must be made in a creamery. The cream shall either be separated at the creamery or hauled direct to the factory from the farms.

Centralized Creamery. Butter offered under this classification must be made in a creamery. Cream used in the manufacture of this butter may be gathered direct from the farmers or shipped in from cream stations.

Held Butter. Butter offered under this classification shall be butter that has become Cold Storage Butter by virtue of the laws of the state in which such butter is sold.

Renovated. Butter offered under this classification shall be such as is made by melting butter, clarifying the fat therefrom and rechurning the same with fresh milk, cream or skim milk, or other similar process.

Ladles. Butter offered under this classification shall be such as is collected in rolls, lumps or in whole packages and reworked by the dealer or shipper.

Packing Stock. Butter offered under this classification shall be original butter without additional moisture or salt, from creamery or dairy (but may be from miscellaneous sources) which has been collected in any quantity and packed in barrels, tubs or other containers. It must be of quality for human consumption as food and free from adulteration.

2. Commercial Production. a. Creamery Butter. (1) Cream. (a) Source. Cream for butter manufacture should be derived from healthy cows fed on wholesome feeds free from materials which upon ingestion produce objectionable odors and flavors in the milk. Pure water also should be provided such animals. The milk furnishing the cream is separated on the dairy farm, at a skimming station or at the creamery.

On the farm creaming is accomplished by gravity or separated centrifugally by a hand or power machine. For gravity creaming, the

milk is drawn, cooled and aerated quickly, and set in deep or shallow containers, or subjected to a dilution method. Cold water cooling is much more efficient and rapid than air cooling. Air cooling of milk in cellars is objectionable due to slowness and to the absorption of "cellar" odors.

For mechanical separation the milk is delivered as soon as drawn to the separator, strained, and separated while warm (80 to 100°F.). Milk below 70°F. may clog the separator. Before using, separators should be clean, sterile and in good working condition. Separation should be promptly and properly conducted and the separated cream cooled rapidly.

Machine separation has greater skimming efficiency than gravity creaming and produces sweet, pure, uniformly rich, wholesome cream of good quality suitable for high grade butter. Cream testing 30 to 35 per cent milk fat is desirable for butter making. Gravity cream frequently tests below 30 per cent fat, is old, sours and spoils readily, and yields an inferior butter.

Machine separated cream in a sweet condition may be delivered daily to a nearby creamery. At other times gravity or machine separated cream may be delivered two or three times a week to a local creamery or shipped to one centrally located. Cream is best when fresh. During transportation, cream should be kept at a low temperature and the cans protected.

Instead of cream separation at the farm, the warm milk may be delivered to a skimming station or to a creamery for mechanical separation. Cold milk is warmed slowly to 90°F. prior to separation. Warming old milk encourages bacterial activity with an increase in sour, bad or other off-odors and flavors. Pasteurized milk should be cooled to 100°F. before separation to prevent the clogging of the separator. From the skimming station the cream is delivered to the creamery. Butter made from cream separated from fresh, whole milk at a local creamery is called "whole milk" butter.

(b) Grading. When received at the factory cream is graded as sweet and sour cream. Sour cream is graded further according to odor and flavor. No. 1 grade is free from objectionable or abnormal odors, flavors and other specific defects. No. 2 grade may contain curdy, weedy, garlicy, yeasty, gassy or other objectionable odors and flavors yet free from putrefaction. All decomposed or otherwise unfit cream should be rejected. Sanitary laws in some States require such cream to be emptied into the sewer or otherwise destroyed for food purposes.

In grading cream, the operator should be provided with a suitable container of hot water, an automatically rinsed sanitary dental spittoon and some clean "tasting" spoons, glass rods or hard-wood maple sticks the size of lead pencils. The grading room should be free from drafts, smoking and off odors. In grading each can, its contents should be stirred vigorously with a clean implement, the odor noted, a tasting spoon or rod dipped lightly into the stirred cream, the flavor noted, the tasting spoon returned to the container of hot water, and the mouth freed from cream by expectorating into the dental spittoon. Two or more tasting spoons or rods should be used, alternately. Under no circumstance should the fingers be used to collect cream for tasting, or expectoration on the floor ensue. Milk also is graded upon receipt along the same lines as for cream.

(c) Sampling. Milk or cream is sampled and tested for milk fat content and acidity. In sampling milk it is agitated and a representative sample secured with a graduated pipette, milk thief or small dipper. Samples may be individual or composite. Composite samples for butter fat analyses may be preserved with bichloride of mercury or other suitable chemical. They should be sealed tightly, kept cold and tested when not over seven days old. Individual or composite samples of cream may be taken with a cream thief or a dipper which is well rinsed with hot water. Frozen, lumpy or thick cream should be warmed to from 110 to 130°F. before sampling. Churned cream cannot be sampled with any degree of accuracy.

(d) Weighing. Milk is "dumped" through a fine meshed wire strainer into a "weigh" can or vat, weighed, heated and separated. Cream is "dumped" and weighed. Sour cream is strained through a coarse strainer into the fore warmer and heated to 90°F. prior to its neutralization.

(e) Can Washing. Emptied cans are inverted, steamed or rinsed with hot water to recover any remaining cream, washed, rinsed, steamed and dried. Cans and lids are washed by hand or machine. Cans returned to the producer should be clean, dry, sanitary and free from off odors. Rusty and damaged cans and lids are objectionable.

(f) Reduction of Acidity. Butter made from sour cream with a high degree of acidity (as 0.7 per cent) may have undesirable flavors and lowered keeping properties. The excess of acidity in sound cream may be reduced through the proper use of a known solution of carbonate, bicarbonate or hydrate of sodium, calcium carbonate or lime in the form of lime water or milk of lime. For this purpose a test is made

on the cream to determine its acidity, the cream is heated to about 90°F., agitated, and a definite amount of the titrated neutralizer in solution is sprayed into the cream to insure uniform distribution. Usually the desired acidity is from 0.2 to 0.25 per cent of lactic acid. This is checked by a retest.

The improper use of lime may result in a "lime" flavored butter, while an excess of sodium bicarbonate, carbonate or hydrate may impart a soapy character to the finished product. Butter produced from rancid, decomposed or otherwise unsound cream neutralized in whole or in part with chemicals before churning, is considered adulterated butter. A Federal tax of 10 cents per pound is imposed on such butter.

(g) Pasteurization. Sweet or sour cream prior to churning is pasteurized by the vat, or the flash method to kill disease producing organisms, to reduce the number of saprophytic bacteria, to destroy undesirable enzymes and to remove objectionable gases and volatile substances. Pasteurization of sweet cream increases its churning qualities with a lessened loss of milk fat in the buttermilk.

One investigator found 13.2 per cent of raw cream butter examined to contain B. tuberculosis. Another found the duration of life of virulent B. tuberculosis in raw cream butter stored at 10°C. below zero, to vary from four days to nine months. One author reports the organism of typhoid to persist active in butter as long as twenty-one days. The reduction of diverse saprophytic bacteria, the destruction of fat splitting and proteolytic enzymes, and the removal of gases and volatile substances from cream result in a butter of better keeping qualities, more free from off odors and undesirable flavors and with more uniform quality.

Butter made from pasteurized cream has more of a dull, compact body and salvy consistency than has raw cream butter. Marked defects of body and flavor occur in butter when slow or prolonged heating is given the cream. Slow cooling of pasteurized cream may produce a mealy textured butter. Heating cream above 185°F. results in a burnt flavor.

For the destruction of organisms the flash system is reported not as satisfactory as the holding system, on the other hand vat pasteurization may not destroy objectionable enzymes. A combination of the flash and holding systems may be employed. Pasteurization of very rich cream may result in butter having a salvy body.

In conjunction with pasteurization, methods may be employed to remove objectionable gases, odors and flavors by aeration or by blowing

filtered air through the hot milk. However, butter made from such cream usually is of lower grade with a mealy body and lowered keeping properties due to oxidations.

It is a good plan to pasteurize all skim milk to be returned to farms to inactivate pathogenic organisms.

(h) Ripening. Butter may be made from sweet, partly sour or sour cream. Sweet cream butter has a delicate aroma and an insipid or mild flavor which increase under proper storage conditions. Sweet cream butter usually has good keeping qualities.

Souring or ripening of cream whether natural or artificial, is the production of a desirable lactic acid content by means of certain strains of Streptococcus lacticus, to facilitate ready and exhaustive churning and to produce butter of desirable aroma, flavors, texture and uniform quality. Ripened cream butter does not keep as well as sweet cream butter, and is intended for rapid consumption.

Natural or spontaneous ripening of cream produces uncertain results in butter due to the presence of more or less peptonizing and putrefactive bacteria which tend to impart off flavors and lower the keeping qualities.

Cream for churning may be ripened by means of starters. Starters are materials such as spontaneously soured whole or skim milk; sour cream or buttermilk from a previous churning; or whole milk, skim milk, diluted condensed milk, redissolved skim milk powder or cream soured by a known pure culture of lactic acid organisms in liquid or dry form.

A "mother" starter is prepared first in small amounts daily in order to propagate the culture. From the mother starter the "big" starter is prepared. "Mother" starter may be prepared by pasteurizing whole or skim milk in glass jars at 180°F. for thirty minutes, cooling to 70°F., inoculating the milk with starter culture, stirring thoroughly and allowing the milk to ripen at 60 to 85°F. twenty-four hours or until the acidity is about 0.7 per cent. This is indicated by the formation of a soft, custard-like curd. A higher acidity as indicated by a hard, lumpy curd, tends to destroy lactic acid bacteria.

The "big" starter may be prepared from clean, fresh milk or skim milk; diluted, plain condensed bulk, skim milk; or redissolved, skim milk powder; pasteurized at 180°F. for one hour, cooled to 70°F., the "mother" starter added, agitated, and then held at 60 to 75°F. for such a period as to produce an acidity of 0.8 to 0.9 per cent. This is indicated by a smooth, sharp flavored curd, free from gas holes.

Starter may be prepared in "starter" cans or cream ripening vats. Copper-lined starter cans or vats are objectionable since the lactic acid of the starter acting on the copper produces salts which impair the keeping qualities of the butter and produce fishy, metallic, tallowy or other flavors. About 2 quarts of good "mother" starter are sufficient for 200 gallons of milk.

Starter Score Card
(*Hunziker*)

Name.. Date..........................

	Score		Description
	Perfect	Actual	
Aroma......	20		Clean, pronounced, pleasant, no taints
Flavor......	40		Clean, pronounced, snappy, free from yeasty, cheesy, curdy and other off-flavors
Body........	20		Smooth, soft, creamy, no gas holes, no whey
Acid........	20		0.8 to 0.9 per cent acid
Total..	100		

The big "starter" is used at once or cooled to 50°F. or below. From 5 to 20 per cent more of starter is added to the pasteurized and cooled cream for churning, then agitated and the cream ripened at 48 to 70°F. until the desired amount of acidity, whether high or low, is produced. This varies with the per cent of fat in the cream also the trade demands.

Ripe cream has a clean, pleasant, distinct acid odor and flavor, a glossy surface, a syrupy consistency, and is smooth.

Butter made from overripened cream may develop off odors, fishy or other abnormal flavors, be defective in texture and have lowered keeping qualities.

After ripening, the cream temperature is reduced and held at 50 to 55°F. at least two hours prior to churning.

Instead of ripening the cream, starter may be added to sweet cream just before churning or mixed with the butter before working, to develop desirable flavors and odors.

(i) Churning. *Churns.* There are two main types of churns, those with internal agitators as the dash and rotary churns and those in which agitation is produced by the turning of the churn itself. The latter may be equipped on the interior with shelves or workers attached to the sides to raise and to drop the butter on rollers with each revolution of the drum. Properly constructed churns made of close-grained

hard wood, and especially of cypress, ash, oak or white beech, are desirable. Those made of metal or soft wood, as pine, are not so desirable.

In order to remove woody, bitter, musty or other odors in new or old idle churns, they may be filled with a solution of milk of lime and allowed to soak several days. The solution then is drawn off and the churn is rinsed with several changes of cold water and a final washing given with boiling hot water.

After using, a churn should be washed with a boiling hot alkaline solution followed by a thorough washing with clean boiling water. The churn should be dried out. Fixtures may be steamed. Covers should be left open and the churn sunned if possible. A damp churn soon becomes musty.

Immediately before using a churn should be steamed, then chilled by means of pure cold or ice water. A cold churn is necessary to prevent the butter from sticking to the churn.

Filling the Churn. Cream testing about 30 to 33 per cent fat and at a temperature of 50 to 55°F. is run through a strainer into the churn. The strainer removes possible foreign material and lumps of curd. These latter if incorporated into the butter would produce white specks or a mottled or streaked butter. The churn is filled about one-third to one-half full. An approved harmless butter color in the quantity desired may be added.

Agitation. After starting the churn it should be ventilated by opening the vent 1 or 2 times the first five minutes for the escape of expanded air and gases from the cream.

By agitation of cold cream the milk fat separates from the caseous and serous constituents. Butter is produced through the solidification of the fat in the fat globules by cooling and concussion, the coalescence of the solidified fat globules into butter granules and the progressive adhesion of the butter granules. Churning occupies from forty to fifty minutes during which time the cream first thickens due to air incorporation, the butter granules form, enlarge in size and the emulsion suddenly breaks due to the separation out of the butter granules from the buttermilk.

Sometimes the butter does not come and the cream foams, nearly filling the churn. This may be caused by cream from sick cows, containing colostrum or being too cold; or by the churn being too full or to too high speed.

When butter gathers in granules the size of kernels of wheat or corn and the buttermilk has a thin, water, bluish appearance, churning is completed and the churn stopped. Overchurning produces an excessive incorporation of buttermilk in the butter lowering its keeping qualities by hastening fermentative and deteriorative changes; imparts unclean, rank, or other off flavors and odors; injures the grain and results in a salvy, weak body.

(2) Butter. (a) Washing. The buttermilk is drained off through a strainer and disposed of in its original condition, concentrated, or dried. It should not test more than 0.1 to 0.2 per cent fat.

According to Federal Food Inspection Decision 178, April 17, 1919, buttermilk is defined as follows:

> Buttermilk is the product that remains when fat is removed from milk or cream, sweet or sour, in the process of churning. It contains not less than eight and five-tenths per cent (8.5 per cent) of milk solids not fat.

The butter in the churn is washed with 2 or more changes of pure water to remove undesirable flavors and non-fatty substances including buttermilk, and to harden the butter if necessary. The wash water should be pure being free from microörganisms and organic and mineral matter. Its temperature is controlled by the hardness or softness of the butter but usually varies from 54 to 58°F. Just enough water is introduced into the churn as will replace the buttermilk. A few revolutions are given the churn, the churn stopped and the wash water is drained through a strainer. The butter is washed until the wash water is clear. Usually two washings are sufficient. Avoid excessive washings.

(b) Salting. Butter is salted to facilitate the removal of buttermilk, to improve the flavor and to aid to some extent, the keeping qualities. Some butter is not salted but is sold as "sweet" butter. The salt used should be bacteriologically and chemically pure and free from dirt or other foreign material. Magnesium in salt imparts a bitter flavor to the butter. Gypsum reduces the solubility of salt. Salt may be added to butter in dry or softened form or in solution. Dry, clean, fine salt may be sprinkled over the butter in the churn and worked, or added at the worker. Salt may be moistened before its addition to butter. Usually $\frac{3}{4}$ to $1\frac{1}{2}$ ounces of salt are added per pound of milk fat to produce butter of $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent salt content. Defects due to wet or dry salting include a coarse, gritty or mottled butter or distinct briny flavor. Butter in the churn may be subjected

to two washings with saturated brine. This produces butter with a salt content of 1 to 2 per cent. In any event the salt content should be uniform and pleasing.

(c) Working. Butter may be worked mechanically in an independent worker or in a combination churn and worker. Working is for the purpose of dissolving and distributing the salt, to control the moisture content, to compact the butter, to improve the grain and texture and in the case of salted butter, it whitens the product. The temperature of the churn, the churn contents and of the room should be such as to produce a butter with a waxy body. This usually is about 50 to 60°F. Too low a temperature would produce a tallowy butter while too high a temperature would result in a greasy butter and an increase of incorporated moisture. A churn worker should not be overloaded. With independent workers the hands and arms should not contact the butter and the butter should be pressed and not rubbed.

Insufficiently worked butter may be gritty and mottled, with an uneven salt and moisture distribution and a crumbly, loose, open body which lacks compactness. Overworked butter may have a greasy, tallowy or salvy texture; defective grain; dull, lifeless color; impaired flavor and an increased moisture content. A plug of such butter breaks with a smooth surface.

Butter should be worked until it has a bright, uniform color and a waxy, tough, compact body. A plug of such butter breaks with an uneven edge showing an intact grain. Before removing from the worker, salt and moisture tests should be made. Butter containing an excess of moisture, milk or cream or any foreign substance added to cheapen the product, is considered as adulterated.

The increase of butter over the milk fat is called the "overrun" and averages 15 to 22 per cent.

(d) Packing. From the churn, the butter may be removed and packed into various style packages or placed into trucks. Usually wooden tubs of 60 to 63 pound net capacity or wooden boxes of various dimensions, are used. These may be intended for the wholesale trade or for packing preparatory to division of the butter into prints. Crocks, firkins, tin pails and other receptacles also may be used.

Tubs, tub covers and boxes of white ash or spruce, free from resinous, porous, moldy or decayed wood, sound and air tight, are desirable. Until used they should be stored in a clean, dry place. Before using they may be washed and scrubbed with a hot alkaline solution, rinsed, soaked overnight in a saturated solution of hot brine to inhibit mold;

steamed with hot, dry steam until the containers are hot and dry; and paraffined on the inside with paraffine heated from 250 to 260°F. The paraffine may be introduced into the hot tub or box and distributed by a circular motion, or sprayed into the container. This fills the pores and cracks and aids in checking mold growth, and loss of moisture.

The tubs are cooled and lined with properly treated parchment liners to prevent the butter from sticking to the tub, and to protect against woody odors, contaminations and mold. Until used, liners and circles should be stored in a clean, dry place protected from dust. Only the best quality of liners, of proper size should be used. Inferior liners may impart off flavors to butter. Before using, liners should be soaked at least five minutes in boiling supersaturated brine to destroy molds and to remove excess of glucose from the liners.

In removing butter from a churn the hands should not be used. A ladle which has been washed, steamed and kept in cold water to prevent sticking is desirable. Clean cotton or rubber gloves may be used, but the practice of the operator in placing his head and superior part of the body into a churn is objectionable. The operator should be clean in person and clothing.

The butter should be packed carefully and firmly in a compact mass in the container eliminating air pockets. The container should be full, surface smoothly finished, liners neatly folded over, top circle adjusted, cover fastened on securely and the container weighed. The net, tare and gross weights and other data is marked on the container and the package of butter placed into the refrigerator to harden, later to be divided into prints or until shipped; or frozen to hold.

Boxes or tubs of hardened butter may be moulded or cut into 1, 2 or 5 pound rolls or into $\frac{1}{4}$, $\frac{1}{2}$ or 1 pound prints for retail trade by the use of special machinery or devices. These may be packed in wooden or corrugated paper boxes or in paper cartons and properly weighed and labeled.

The standard size for a 1 pound print is $2\frac{1}{2}$ by $2\frac{1}{2}$ by $4\frac{5}{8}$ inches. One pound prints may be wrapped in properly treated parchment paper then enclosed in a paper carton. Sometimes a waxed paper is placed around the parchment covering and the carton enclosed in a tight paper covering. Four, $\frac{1}{4}$ pound prints individually wrapped, may be enclosed in a carton. At other times $\frac{1}{4}$ and $\frac{1}{2}$ pound prints may be wrapped in parchment paper and enclosed in cartons.

Parchment paper should be free from metallic specks due to copper or copper alloy. If such is used to wrap butter, green spots due to

verdigris will form on the butter and later the entire print may become bleached and have a tallowy or other rank flavor and odor. Waxed paper is that which has been dipped into hot, melted paraffine and has a coating of paraffine on both sides.

Cartons should be labeled in compliance with all pertinent food laws. Usually for packages of 1 pound or over, the net weight is indicated in terms of pounds, while for packages less than 1 pound the net weight is indicated in ounces. Cartons may be enclosed in wooden or fibre boxes holding 10 to 15 pounds of butter.

Butter may be placed into a clean, hard maple truck, taken to the packing room and packed into cans. Cans should be cleaned, steamed and dry. Cans may or may not be inside-lacquered. No raw edge on the tin plate should be exposed to the action of the acids or brine in the butter or rusting and deterioration will ensue. Tin is inert and cans without inside lacquering should be made of heavily-tinned plate. Aluminum cans may be used. The cans are hermetically sealed, cleaned and packed in cases. The interstices between the cans are sometimes filled with a light packing material as excelsior, shavings, rice hulls, etc.

(e) Storage. For short storage or to harden butter in tubs and boxes, chill room temperatures are employed. For holding purposes butter is stored at 6 to 10°F below zero. Cold storage rooms should be dry and clean. Butter deteriorates in storage due to a combination of complex conditions. First class butter, from good cream properly handled, pasteurized, churned, etc., under proper storage conditions at −10°F. may keep in good condition five to eight months. Inferior butter deteriorates more rapidly than good butter. Chemical, enzymatic and bacterial actions are accelerated by air, moisture, light and heat. Butter containing salt, high acidity or traces of catalytic agents, is more prone to deteriorations. Due to long storage butter loses its characteristic fresh odor and flavor and develops storage flavors and odors. Due to decomposition of non-fatty constituents butter may gain an oily flavor, this gives place in time to a metallic flavor, and this to a fishy flavor.

Unsalted butter does not shrink as much in storage as salted butter, and light salted butter shrinks less than heavily salted butter.

POINTS LOST AFTER STORAGE
(*Rogers, Thompson and Keithley*)

KIND OF BUTTER	STORED AT 0°F.	STORED AT 10°F.	STORED AT 20°F.
	points	*points*	*points*
Raw cream butter, Cry. A	5.0	5.3	5.8
Raw cream butter, Cry. D	1.7	4.1	3.3
Raw cream butter, all samples	3.2	4.6	4.8
Pasteurized ripened cream, Cry. B	2.2	3.0	5.1
Pasteurized ripened cream, Cry. E	1.7	3.6	4.0
Pasteurized ripened cream, all samples	2.0	3.3	4.6
Pasteurized unripened cream, Cry. C	0.6	1.0	1.5
Pasteurized unripened cream, Cry. D	0.4	1.0	1.6
Pasteurized unripened cream, all samples	0.5	1.0	1.6

Under proper storage conditions, non sterile canned butter of high grade may be kept several months. However, a gradual change of texture and flavor usually is noticed with a slight increase in acidity but with a decrease in bacterial content. Some canned butter in storage showed an off flavor in twenty-five days and a disagreeable, penetrating, fishy odor and flavor in eight months.

(f) Shipment. Butter in large quantity should be shipped in properly precooled refrigerator cars as discussed under fresh meats, Chapter VIII. Cooperative shipping in carload lots via refrigerator service is practiced by some small creameries.

b. Whey Butter. Whey resulting from the manufacture of cheese contains 0.3 to 1 per cent of milk fat. This fat can be recovered and made into butter of a quality approaching creamery butter. From the cheese vat, the whey is centrifugally separated to produce a cream containing 50 to 75 per cent fat. The cream may be pasteurized, promptly and effectively cooled, mixed with 75 to 100 per cent of a cold, thick starter, ripened about twelve hours, churned at 45 to 50°F. and the butter granules while still small washed at a temperature of 40 to 45°F.

c. Ladled Butter. Miscellaneous lots of butter may be mixed and reworked to secure a uniform product called "ladled" butter. Such butter is not held to be renovated unless melted and refined. It is not held to be adulterated unless containing 16 per cent of moisture; an excess of milk or cream; or foreign substance added to cheapen the product, to deodorize or to remove rancidity or decomposition.

d. Renovated Butter. According to Federal Food Inspection Decision 190, January 19, 1923, renovated butter is defined as follows:

Renovated Butter, Process Butter, is the clean, sound product made in semblance of butter from melted, clarified, or refined butterfat, without the addition or use of any substance other than water, milk, cream, or salt, and contains, all tolerances provided for, less than sixteen per cent (16.0 per cent) of water, and not less than eighty per cent (80.0 per cent) of milk fat.

In renovating a poor grade of butter, it may be melted at 120°F. and run into a settling tank. Here the "slush" consisting of water, curd and some other impurities, settles to the bottom, is drawn off, centrifugally separated and the recovered fat returned to the settling tank. Next, prolonged aeration at 110 to 120°F. is conducted by blowing heated, washed air through the melted fat until all off odors are removed and the fat is "neutral." The oil is pasteurized at 160°F. Up to 50 per cent of good starter is added and mixed with the butter oil, and authorized coloring matter may be added. The emulsion of starter and fat is run in a fine stream into a long vat filled with cold water, refrigerated by means of ice or brine coils and kept under agitation. The emulsion crystallizes out in flakes, is removed, placed on trays, held in a tempering room at 65 to 70°F. twelve or more hours to ripen, after which it is salted, worked, packed and labeled in compliance with existing food laws. A Federal tax is imposed on renovated butter.

3. Veterinary Examinations. a. Scope. The veterinary examinations of butter and buttermilk intended for troops begin with a consideration of the sanitary source of such products; include veterinary dairy farm inspection as outlined in Chapter XVII, the subsequent sanitary handling and transportation of the milk or cream, the selection of authorized, specified ingredients used including cream or milk, starter, salt, coloring matters and water, their sampling, testing and grading for sanitary quality; and the supervision of the sanitary requirements relating to all processes including receipt, grading, weighing, dumping, heating, mixing, cooling, ripening and churning of the milk or cream, and the washing, salting, working, testing, weighing, wrapping, packing, labeling, handling, storage, shipment, receipt and issue of the finished product, with such reinspections as are required. There are considered also the sanitary location, construction equipment and methods of operation of establishments involved as defined by Army Regulations (See Chapter III, Handbook); the national and state pure food laws and regulations regarding standards, authorized ingredients, weights and labeling, and purchase requirements.

b. Inspections Prior to Purchase. The inspections prior to purchase are the examinations made during manufacture or when butter is offered for sale to the Government at purchasing points or in the field and include examinations for sanitation and soundness. In any event the inspecting veterinary or medical officer should be informed a sufficient length of time in advance, when and where butter is to be prepared and every opportunity and facility should be furnished the veterinarian for the proper inspection of all products. Inasmuch as disease germs frequently are present in butter, a correct opinion can hardly be formed regarding the fitness of butter for consumption merely by just an organoleptic or chemical examination of the finished product. In order to insure butter being prepared from officially inspected and passed, authorized products and ingredients, in compliance with sanitary requirements and those of purchase, a sanitary veterinary supervision is necessary at the producing dairy farms involved as outlined in Chapter XVII, over the subsequent handling of the milk or cream, and the manufacture of butter at the factory. In the event it is necessary to purchase the finished product, its sanitary source and production should be indicated by the presence of the standard markings of an official and competent sanitary inspection agency, however, a further sanitary organoleptic reinspection is required to be supplemented when deemed necessary, by Medical Department laboratory examinations.

(1) Sanitation. Strict sanitary measures should be employed throughout all manufacturing operations (See Chapter III). A butter factory should be free from all undesirable, foreign or off odors, which if present may be absorbed by the butter with its lowered quality and keeping properties. Churns should not be musty, and should be scalded and steamed after each churning. Can tops, dippers, strainers, churn tops, separator parts, starting can agitator and top, and butter tub covers should never be permitted to touch the floor. Receiving vats, cans, separator parts, prewarmer, pasteurizer, holding vats, cooling apparatus and ripening vats at the end of each day's operation, should be washed, cleansed, steamed and dried; and rinsed before using. Water allowed to remain in metal equipment tends to impart metallic flavors to butter. All vats should be covered properly to prevent contamination. The clothing, hands and arms of employes should be clean. No part of the clothing, hands or body should come into contact with the butter or the inside of a container. Expectoration on floors should be prohibited. Sampling should be conducted in a sanitary manner.

(2) Preparation. (a) Ingredients Used. The proper care of the raw milk or cream on the farm and its handling before it reaches the manufacturing establishment are very important. The milk or cream used in the manufacture of butter should be pasteurized, unless free from B. tuberculosis, as shown by tuberculin test of cattle and dairy farm inspection. Cream used in making butter should be of good grade, as shown by butter fat test. The flavor should be of good quality, as shown by the taste and smell. Cream in good condition at a creamery should not be too acid. Decomposed or rancid cream or that having a high acid content and bad odor, should be rejected. Butter produced from such cream which has been treated by aeration or neutralization, is considered adulterated. The method of handling cream for manufacturing of butter should insure its cleanliness. Pasteurization should be thorough and properly conducted.

Undesirable bacteria should not be used in starters. Starters should be handled properly. The use of rennet is undesirable. Only approved vegetable coloring substances should be used. Water used in the manufacture of butter should be examined as to source and purity. Salt used should be clean, white, silky in appearance and dissolving quickly in water, and should not be dark-bluish, coarse or granulated in appearance. Magnesium chloride in salt will impart a bitter flavor to butter. Salt should be stored in a clean dry place, free from odor. Whenever necessary, samples of ingredients used should be retained, properly prepared and forwarded to a Medical Department laboratory for bacteriological, acidity, salt, moisture or other tests, in compliance with Army Regulations.

(b) Initial or Churn Inspection. After churning, washing, salting and working, while the butter is in the churn or on the worker a tentative inspection should be given the butter, considering soundness, flavor, body, color, saltiness and moisture.

The initial moisture and salt tests are made before taking the butter from the churn or worker. In order to secure a representative sample of butter it is necessary to take small portions of butter from all parts of the churn. Water pockets should be considered, but avoided in sampling. Veterinarians should observe and check moisture and salt tests conducted by an establishment on butter intended for the Army.

Moisture Test. The official moisture test as adopted by the Association of Official Agricultural Chemists is preferred. A factory test may be conducted as follows: Churn samples from both ends and the center of the drum are taken with a dry, warm spatula

or spoon. Mix well. Balances should be checked. An aluminum cup is washed, dried, heated and tared, weighing to the third decimal point. Transfer 10 grams of mixed sample of butter to tared cup. Slowly heat sample over hot plate or flame, stirring it with a thermometer. Remove flame at 260°F. The temperature may continue to rise to about 280°F. Upon it cooling to 240°F., heat sample again as before. Evaporation of moisture then should be complete. Weigh aluminum cup and calculate per cent moisture. A slightly brown curd in the bottom of the cup indicates sufficient heating, a dark brown curd overheating, while a whitish-yellow curd insufficient heating. After using the thermometer it should be scraped off on the cup to avoid removing any of the sample from the test.

Salt Test. The official method of quantitative salt determination for butter as outlined by the Association of Official Agricultural Chemists is as follows:

Weigh in a counterpoised beaker 5–10 grams of butter, using portions of about 1 gram from different parts of the sample. Add about 20 cc. of hot water and, after the butter is melted, transfer the whole to a separatory funnel. Insert the stopper and shake for a few moments. Let stand until all the fat has collected on the top of the water, then draw off the latter into a flask, being careful to let none of the fat globules pass. Again add hot water, rinsing the beaker, and repeat the extraction 10–15 times, using 10–20 cc. of water each time. The washings will contain all but a mere trace of the sodium chloride originally present in the butter. Determine the amount in the whole or an aliquot of the liquid by titration with standard silver nitrate, using potassium chromate as an indicator.

Physical Examination. Flavor. It is impossible to describe the flavors of butter. The following terms may be used in describing the flavor of good butter; fine, high, mild, pleasant, rich, creamy, clean, sweet or plain. The flavor may be "slightly off" or undesirable due to absorbed odors or other conditions, such flavors being described as: barny, cowy, dirty, musty, old milk or creamy, summery or wintry, tainted, weedy, fishy, sewerage, poor water or ice, flat, light, stale, strong, bitter, too acid, sour, cheesy, rancid, feverish, stable, etc.

A "flat" flavor is found in butter made from unripened cream. Rancid refers to an undesirable, strong flavor, which is the most common defect developing in butter on standing. Other flavors which may develop on standing are turpentine, fishy, unclean, feverish and stale. Cheesy flavor very commonly develops in butter with little or no salt and is ascribed to decomposition of protein matter. Weedy flavors are due to the condition of the milk, from cows eating especially rag weeds, wild onions or garlic. Acid flavor is due to the improper ripening

of cream. Sourness obtains to the non-removal of buttermilk before the butter is packed. Feverish or sickening flavors are thought due to oestrum of the cow, or ill health as diarrheas, etc. Stable flavors pertain to improper or unclean stable conditions, usually more pronounced during winter.

Body. In body, the butter should be firm and waxy and not weak, salvy, greasy, tallowy, milky, leaky, short grained or loose.

Moisture should not be in excess of requirements and standards or too scant in amount, and should be incorporated properly.

Color. Butter should be fine, uniform, bright, and light straw or light yellow in color. It should not be wavy, streaked, variable, mottled, extremely high or low, or not of a good shade as too reddish hue. Unevenness is the chief fault. A plug held to the light should not be cloudy or dense, but transparant or bright.

Saltiness. The salt should be fine, smooth, evenly distributed and well dissolved. It should not be gritty, fishy, irregular, poor in grade, or too high or low in content. Light salted butter contains salt up to 1.5 per cent, medium salted 1.5 to 3.5 per cent, and high salted butter over 3.5 per cent of salt. Butter containing 3 to 5 per cent of salt has a sharp flavor, while above 5 per cent it is strong.

(c) Packing. All packages as specified should be clean, uniform, in good repair, free from mold and preferably paraffined on the inside.

Tubs. Tubs, tub covers and liners should be stored in a clean, dry place and protected from dirt and other contamination. Tubs should not be flimsy, have broken hoops or tops, dark colored staves, soaked too much, or be discolored, dirty, muddy or mouldy. Tubs should be properly paraffined and paper lined. Parchment paper usually is more clean and tougher than other papers. A poor grade of liners should not be used. Liners should be free from copper salts and properly sterilized by means of boiling brine before using. Disinfection with formaldehyde, hypochlorite of soda or other chemical disinfectant, is not desirable.

Tubs should be full and not loosely packed and the top of the butter should be finished evenly. Liners should be folded over nicely and the top circle placed in proper position. Covers should be placed on securely. Weights should be checked carefully and tubs labeled properly.

Prints. Liners should be treated properly. Weights should be checked, and the wrapping, labeling and packing accomplished according to sanitary and all other pertinent standards and requirements.

Cans. Cans as specified should be properly washed, sterilized and dry. No raw edges of tin plate should be exposed on the inside of the cans. The butter should be filled into cans without delay. Cans should be filled solidly and completely to eliminate all air space. Sealing should be expedited. Sealed cans should be cleaned thoroughly. This may be accomplished by rubbing with clean sawdust or by wiping with turkish towels which have been immersed in hot water and "wrung out." All cans should be tested for leaks by pressure on the sides and top of each can, small beads of moisture appearing wherever a leak occurs. Defective cans should be rejected. Weights should be checked carefully, and scales tested at frequent intervals. Packing and marking of cases should comply with all pertinent requirements.

(3) Inspection of the Finished Product. This is the examination conducted subsequent to packing and cooling in accordance with the sanitary and purchase requirements. Such examination includes sampling of butter to be inspected; organoleptic inspections of the package, and the soundness, color, flavor, saltiness and body of the product; also such moisture, salt or other laboratory examinations as are required.

(a) Sampling. The veterinarian should note the number of packages in the lot to be inspected and record all regular identification marks.

Sample packages of butter to be examined, whether in tubs, cases, cartons or tins should be selected by the veterinarian in such a manner as will be representative. Consideration should be given separate churnings and lots. The number of packages selected should vary with the size of the shipment or lot, somewhat as follows:

Out of a lot containing 10 or less packages, 3 packages should be drawn and inspected; for 25 packages, 6 samples; for 50 packages, 10 samples; for 100 packages, 15 samples; for 150 packages, 17 samples; for 200 packages, 19 samples; for 250 packages, 20 samples and for lots above 250 packages one additional sample package for each additional 50 packages or fraction thereof.

When butter in any lot is unsound, not up to specifications or not uniform in any quality, and when required, the veterinarian may examine additional sample packages as necessary.

In sampling prints, cartons or cans, each sample package should be opened, and a sufficient number of prints or cans examined to determine soundness and to properly establish the score.

(b) Organoleptic Examination. This is conducted for soundness, and compliance with purchase requirements.

Score Card. The national, standard score card for salted creamery butter, in general use in all parts of this country is made up of six factors of the following maximum ratings: flavor 45 points, body 25 points, color 15 points, salt 10 points, package 5 points and total score 100 points. Factors without defect are given their maximum ratings while those showing defects are cut according to the extent of deficiency. The values given the different factors are considered in fixing the final score within the limits of the grade under which the score comes, as the rating of the last 4 grading factors is considered as being contingent to that given flavor.

Conditions of Inspection. The veterinarian should conduct the examination in a room maintained at a temperature to keep the butter in good condition. If too warm the butter will soften affecting the body and texture, while extreme cold will prevent the detection of distinctive aromas. The room should be free from odors, including smoking so as not to mask odors. Abundance of natural light should be provided for proper examination of the color, body and texture characteristics. A correct standard scale in good working condition should be available. The veterinarian should have a standard butter trier of proper dimensions, a clean knife (not a pocket knife) or spatula and some clean cheese cloth. The trier should be plated with nickel, silver or tin and in good repair, free from rust and places where the plating has been removed. If possible frozen samples should be spaced in a chill room twenty-four hours prior to inspection in order that the finer, distinctive variations in aroma and flavor may be detected.

Routine of Inspection. Package. *External Examination.* The veterinarian should examine tubs, cases and cartons as to specification requirements including markings, kind, style, size, cleanliness, soundness, neatness, uniformity and proper closing or fastening. Such containers should be new, substantial, in good condition and free from mold, broken or damaged parts or evidence of contamination.

The external examination of cans should be along the same lines as discussed under Chapter X, "Canned Meats."

Weighing. Each tub should be weighed and the gross weight marked on the outside. The tubs should be stripped, the tare determined and the net weight computed. Samples of prints and cartons should be stripped of all wrappings and weighed. A tolerance of $\frac{1}{4}$ ounce per pound print is sometimes allowed provided such variation is not a frequent shortage. The net weight of canned butter is determined as discussed under Chapter X, "Canned Meats."

Internal Examination. The inside of each tub should be examined as to coating and mold. Liners and circles should be examined as to soundness and purchase requirements, including freedom from mold or metallic spots; kind, condition, neatness and suitability. The top of the butter should be smooth, even and well finished. The wrappings of prints should be inspected as described for tub liners. There should be no evidence of soiled-finger marks on the butter or liners. The inside of cans should be examined as to specification requirements, cleanliness and freedom from raw edges of tin plate.

In rating "Package" on the standard score card, consideration should be given the general appearance, soundness, care in packing and finish. This includes the general cleanliness, neatness and attractiveness and the proper adjustment of liners or wrappers. Seldom is a cut made on package if neat and clean. When untidy, soiled, rat or mouse eaten, discolored, moldy, carelessly lined, not finished properly or if the package is unsound, a cut is given, the higher the quality of butter the greater the cut. When carelessness is evident a cut of $\frac{1}{4}$ to 2 points is made and in case of extreme carelessness as high as 5 points are deducted.

Butter. The veterinarian should wash his hands with soap and water, dry them, clean a butter trier and draw a representative plug from the butter. Tub butter inverted and freed from the package may be tried from the bottom to the top, or the trier may be inserted diagonally in such a manner that the bottom, outside, central and top parts are all represented in the plug. Cubes of butter, and canned butter free from the cans, may be tried from end to end.

Color. The butter on the outside of the plug should be examined under good natural light, stroking the plug with a clean knife to observe the color, closely noting the exact shade, whether uniform or uneven, high or low, and defects.

The color requirements for butter vary with trade demand. In scoring salted creamery butter, 15 points are allowed for a uniform light straw or medium color similar to a natural grass product provided the product is free from curd specks, mottles, streaks, waviness or other color defect. A higher color than medium requires a cut of one or more points according to intensity. A color lighter than a straw color when it pertains to sound butter is noted but ordinarily no cut is made. A small number of curd specks, pin head in size; small light colored streaks and small light colored spots or mottles are cut $\frac{1}{2}$ to 1 point. Pronounced waviness or mottles are cut 3 to 5 points. A marked dull color is considered a defect.

Any color, color characteristic or discoloration due to any unsoundness, including mold, metallic spots; chemical bleaching, unauthorized coloring matter or sediment of butter color, would require outright rejection of the product for Army purposes except as indicated under issue inspection of superficially mouldy butter.

Flavor. The aroma should be noted by passing the plug under the nose. Care should be taken not to touch the nose with the butter or trier. The aroma should be delicate, mild and pleasant. Its degree of development should be noted.

A small piece of the plug should be removed from the trier by means of a clean knife or spatula (never by means of the fingers or teeth). The character, kind and degree of flavor should be noted, whether desirable, undesirable, foreign or off. During the tasting operation the degree of saltiness may be determined. Body and texture, to some extent can be examined by the feeling to the palate; as greasy, tallowy, spongy or sticky.

Butter with desirable flavors and aromas may be rated from 37 to 45 points for flavor, and if otherwise perfect may have a score from 92 to 100. Such butter is called "extras" or "specials." However butter is never given a full score for flavor, as 38 for flavor and a total 93 score usually are considered perfect. Occasionally some butter may be found scoring 43 in flavor and a total of 98 points. The attributes which indicate the highest index of palatability and quality in butter are desirable flavors and aromas distinguished by sensations of taste and smell and described as delicate, pleasant, quick, full, highly developed, creamy, mild, fine, clean or sweet or a combination of these terms.

Fresh butter that has an unusual, delicate, particularly pleasing sweet, clean, fine, mild, creamy-rich flavor and aroma and a creamy texture, may receive 42 to 45 points for flavor. Otherwise with no defects the total score may be 97 or above.

Fresh butter that has a delicate, particularly pleasing, sweet, clean, fine, mild, creamy-rich flavor and aroma and a creamy texture may receive 40 or 41 points for flavor. Otherwise without defects the total score may be 95 or 96.

Fresh or storage butter that has a particularly delicate, sweet, clean, fine, plain flavor and aroma and a creamy texture may receive 38 or 39 points for flavor. Otherwise without defects the total score may be 93 or 94.

Fresh or storage butter that has a pleasant, sweet, clean flavor and aroma and of fresh appearance may receive 37 points on flavor. Otherwise with no defects, the total score may be 92.

Butter containing undesirable, objectionable flavors, aromas or taints, but pleasant and palatable and free from foreign, stale or old cream or off flavors and odors, may be rated from 33 to 36 points for flavor and if otherwise perfect may have a total score of 88 to 91. Such butter is included under "Firsts." Undesirable flavors and aromas some of which are barely discernible indicate faulty methods of manufacture, old storage, bacterial taints, improper feeds, butter of medium quality, or poor keeping properties. These flavors and aromas may be designated as limy, greasy, lardy, oily, mealy, metallic, heated, burnt; old, storage, musty; summery, acidy, curdy, cheesy or yeasty due to acid cream or high temperatures; wintry, cowy or barny due to stable odors; bitter, weedy, frosted feed and frozen cream.

Fresh or storage butter with a fairly sweet and clean flavor and aroma, with a slight fruity flavor, or a slight taint due to poor milk, or absorbed barny or cowy odors, yet free from foreign, stale or old cream or off flavors and odors, may receive 36 points on flavor. Otherwise with no defects the total score may be 91. Butter scoring 91 sometimes is included under "High Firsts."

Fresh or storage butter that has a fairly sweet and clean flavor and aroma, or flat and lacking a delicate desirable aroma; with a slight wintry, barny, cowy, bitter, poor milk or metallic taint, or a storage or pronounced fruity flavor, yet free from foreign, stale or old cream or off flavors and odors may receive 35 points on flavor. Otherwise with no defects the total score may be 90. Butter scoring 90 sometimes is referred to as "Standards," "Extras Firsts" or "Prime Firsts."

Butter that has a reasonably fresh, sweet and clean flavor and aroma, with undesirable taints and flavors, as discussed in the preceding paragraph, a little more pronounced; or with a slight acid or weedy flavor or other slight defects, yet free from foreign, stale or old cream or off flavors and odors, may receive 34 points on flavor. Otherwise with no defects the total score may be 89.

Butter of a good flavor and odor but with any objectionable flavor or aroma described above, or having a pungent limy or musty taint yet free from foreign, stale or old cream or off flavors and odors may receive 33 points on flavor. Otherwise without defects the total score may be 88.

Foreign flavors and odors are those which are not natural to butter.

Butter having a slight taint of gasoline without other objectionable flavor or odor may receive 33 points on flavor. Otherwise without defects the total score may be 88.

An off flavor or odor is one disagreeable to the taste or smell and in butter indicates a low quality.

Good butter having foreign or off flavors or odors to a minor degree as slight, fishy, oily, metallic or tallowy; unclean, rather dirty, stale or old cream, garlicy, that of wild onions, yeasty, metallic, stale, cheesy or sour; yet free from rancid and strong flavors and odors may receive 32 points on flavor. Otherwise without defects, the total score may be 87.

Butter having a very distinct foreign or off flavor or odor yet not rancid or strong, may receive 31 points on flavor.

Butter having a pronounced foreign or off flavor or odor, yet not rancid or strong, may receive 30 points on flavor.

Butter with a very pronounced foreign or off flavor or odor, yet not rancid or strong, may receive 29 points on flavor.

Butter of a very pronounced foreign or off flavor or odor and slightly rancid or strong on the sides and top, may receive 28 points on flavor.

Butter which is rancid or strong on the sides and top, may receive 27 points on flavor. Seldom is flavor less than 27, but if strongly rancid, bitter, stale, with a combination of all that is bad it may be given a lower rating, the more marked or pronounced the defects the lower the score. Butter whose total is below 75 is classed as "Grease" butter.

Any flavor, characteristic of an unsound condition, irrespective of the score would require outright rejection of butter.

Saltiness. The amount and solution of salt are considered. Salt of a low or medium content is given a full rating on the score card. Butter containing salt in excess of 3½ per cent or having a pronounced sharp briney flavor is cut 1 or more points according to intensity and the total score maximum of such butter is 91 points. Undissolved salt or "gritty" butter is cut ¼ to 4 points. Unsalted creamery butter is scored on the following standard score card: flavor 45 points, body 30 points, color 15 points and package or style 10 points.

Body. A portion of the plug may be squeezed with a clean thumb to note the character of the body. The body should be firm. If upon pressure, brine runs freely in large drops the body is "leaky." Note the appearance of the plug also the back of the trier. When the plug

is irregular, ragged and not solid, and butter sticks to the back of the trier, the butter is said to be "crumbly" or "sticky." A weak body with poor grain is indicated by a dull color and tallowy or salvy condition.

In scoring salted creamery butter, 25 points are allowed for a perfect body as shown by desirable firmness, compactness, granular structure, texture and amount and proper incorporation of brine. Such butter should be firm and waxy, with considerable cohesive strength, and perfect grain as shown by an irregular, jagged, dentated surface when the butter is pulled or broken apart, and free from excess moisture, milky brine, salviness, and other defects.

Texture and grain are closely interrelated and obtain to the structure and arrangement of the minute parts which compose the body or mass as a unit. The texture of butter is open grained when the grain is granular and coarse, and is close grained when the granules are united closely. A short grained or crumbly texture relates to butter with a high moisture content having separate granules in its make up. Butter which is short grained is crumbly and brittle, lacking cohesive strength between the granules. Such butter breaks with a regular, smooth surface. Milky brine is indicative of excessive curd and lowered keeping qualities.

When butter is weak, greasy or salvy but not excessively so, it is cut ½ to 3 points on body. When more extensive or if the grain is short or the brine is milky, 5 or more points are deducted from the perfect score.

After scoring, if the plug is not contaminated in any manner, it may be returned to the package, the surface evened with a trier or spatula, liners or circle replaced and the butter returned to the package or otherwise properly disposed of, and the trier wiped clean.

Total Score. The characteristics of flavor, color, body, saltiness and package pertaining to a sample should be compared with the characteristics allowed under official defined scores and the maximum total score determined.

The characteristics of butter receiving defined scores, according to Federal requirements, May 28, 1919, are as follows:

1. Butter scoring above 94 shall be fine, sweet, fresh, mild, and clean in flavor if of fresh make, or fine, sweet, mild, and clean if storage, with a pleasing creamy aroma and without defect in body, color, salt or package. It must show neatness and care in packing and the package must be clean and attractive. The color and salt may be either light or medium.

2. Butter scoring 93–94 shall be fine, sweet, fresh, and clean in flavor if of fresh make, or fine, sweet, and clean if storage. The defects in body, color, salt, and package shall not total over ½ a point. Color and salt may be either light or medium. It must be well packed in clean, sound, and uniform packages entirely free from mold.

3. Butter scoring 92 shall be fresh, sweet, and clean in flavor if of fresh make, or sweet and clean if storage. The body shall be firm and the color either light or medium. The color must be uniform except that it may show small curd specks or slight waviness. The salt must be either light or medium and free from grittiness. The package must be clean, uniform, and sound. The defects in body, color, salt, and package must not total over 1 point.

4. Butter scoring 91 shall be fresh and fairly sweet and fairly clean in flavor if of fresh make, or fairly sweet and fairly clean if storage. The body shall be fairly firm and may show only slight imperfections in grain or texture. The color may be light or medium and must be fairly uniform, but may be somewhat wavy. The salt may be either light, medium, or high, but must be uniform and free from grittiness. The package must be clean, uniform and sound.

5. Butter scoring 90 shall be fresh and fairly sweet and fairly clean in flavor if of fresh make, or fairly sweet and fairly clean if storage. It may also be flat and lacking in flavor. The body must be fairly firm, but may show slight defects in grain or texture. The color may be either light or medium and must be fairly uniform, but may be wavy. The salt may be either light, medium, or high, and must be fairly uniform, but may be slightly gritty. The package must be clean, uniform, and sound.

6. Butter scoring 89 shall be reasonably fresh, reasonably sweet, and reasonably clean in flavor. The body shall be reasonably firm, but may be somewhat defective in grain or texture. The color may be either light, medium, or high and may show considerable waviness, but must be free from mottles. The salt may be either light, medium, or high and somewhat gritty, but must be fairly uniform. The package shall be uniform and sound.

7. Butter scoring 88 shall be "good," but may show any objectionable flavor. It must not show garlic, rank weedy, or off flavors. The body must be reasonably firm, but may be somewhat defective in grain or texture. The color may be either light, medium, or high and may be slightly mottled. The salt may be either light, medium, or high and may be somewhat gritty and irregular. The package must be uniform and sound.

8. Butter scoring 87 shall be reasonably "good," but may show foreign, unclean, or off flavors except that it must not show any rancid or strong flavor. The body may be weak and defective in grain or texture, but must draw a full trier. The color may be somewhat irregular and may be mottled. The salt may be irregular and gritty. The package must be uniform and sound.

9. Butter scoring 86 may show very distinctly any foreign, unclean, or off flavor except that it must not show any rancid or strong flavor. The body may be weak and otherwise defective, but must be solid boring. The color may be irregular, streaked, or mottled. The salt may be irregular or extremely high. The package must be uniform and sound.

10. Butter scoring 85 may show a pronounced foreign, unclean, or off flavor, except that it must not show any rancid or strong flavor. The body may be

weak and otherwise defective, but must be fairly solid boring. The color may be irregular, streaked, or mottled. The salt may be irregular or extremely high. The package must be uniform and sound.

11. Butter scoring 84–83 may show a very pronounced foreign, unclean, or off flavor, except that it may be only slightly rancid or strong on tops and sides. The body may be weak and ragged boring. The color may be extremely high, streaked, or mottled. The salt may be extremely high and irregular. The package must be uniform and sound.

12. Butter scoring 82–80 may be rancid or strong on tops and sides. The body may be ragged boring. The color may be irregular, extremely high, streaked, or mottled. The salt may be extremely high and irregular. The package must be sound.

13. Butter containing defects of a more marked degree than previously specified shall be given a score below 80, depending upon the extent of the defects.

14. Butter which would score below 75 shall be classified as Grease Butter.

The definition of butter grades adopted by the National Poultry, Butter and Egg Association, April, 1921, are as follows:

EXTRAS

Shall be a standard grade of average fancy quality in the season when offered under the various classifications. Ninety per cent shall conform to the following standard, the balance shall not grade below ninety points.

Flavor—must be sweet, fresh and clean for the season when offered if Creamery, Centralized Creamery or Renovated, and sweet and clean if Held.

Body—must be firm and uniform. *Color*—may be either light straw color, medium or high, but must be uniform and neither streaked nor mottled. *Salt*—may be defined as light, medium or high but must not be gritty. *Package*—new, sound, good, uniform and clean.

STANDARDS

Standards shall be a grade of Centralized butter of average fancy quality in the season when offered. Ninety per cent shall conform to the following standard and the balance shall not grade below eighty-nine points:

Flavor—must be sweet, fresh and clean, and sweet and clean if Held.

Body—must be firm and uniform. *Color*—must be either light straw color or high, but must be uniform and neither streaked nor mottled. *Salt*—may be defined as light, medium or high but must not be gritty. *Package*—new, sound, good, uniform and clean.

FIRSTS

Shall be a grade next below Extras and must be good butter for the season when made and offered under the various classifications. Ninety per cent shall conform to the following standard, the balance shall not grade below eighty-six score:

Flavor—must be reasonably sweet, reasonably clean and fresh if Creamery, Centralized Creamery, Renovated, and reasonably sweet and clean if Held.

Body—must be firm and fairly uniform. *Color*—reasonably uniform, neither very high nor very light. *Salt*—may be reasonably high, light or medium. *Package*—new, sound, good, uniform and clean.

SECONDS

Shall be a grade below Firsts. *Flavor*—must be reasonably good. *Body*—if Creamery, Centralized Creamery or Held must be solid boring. If Ladles or Renovated must be ninety per cent solid boring. *Color*—fairly uniform, but may be mottled. *Salt*—may be high, medium or light. *Package*—good and uniform.

THIRDS

Shall be a grade below Seconds and may consist of promiscuous lots. *Flavor*—may be off flavored and strong on tops and sides but not rancid. *Body*—not required to draw a full trier. *Color*—may be irregular or mottled. *Salt*—high, light or irregular. *Package*—any kind of package mentioned at the time of sale.

NO. 1. PACKING STOCK

Shall be original butter without additional moisture or salt, sweet and sound, packed in new barrels having wooden heads in both ends, or in new tubs, both to be parchment paper lined; barrels and tubs to be packed full.

NO. 2. PACKING STOCK

Shall be original butter without additional moisture or salt, sweet and sound, may be packed in different kinds of barrels, tierces, pails, tubs or good clean boxes; may be without paper lining; may be packed in two-headed or cloth covered barrels.

NO. 3. PACKING STOCK

Shall be a grade or quality above grease butter and packed in any kind or all kinds of packages.

SCORING

The standard official score for salted creamery butter shall be as follows:

	Points
Flavor	45
Body	25
Color	15
Salt	10
Style	5

The standard official score for unsalted creamery butter shall be as follows:

	Points
Flavor	45
Body	30
Color	15
Style	10

EXTRAS

Shall consist of a grade of butter scoring ninety-three points from May 20th to July 31st, inclusive, and ninety-two points from August 1st to May 19th, inclusive.

STANDARDS

Standards shall consist of the highest grade of Centralized butter made during the season when offered and shall score ninety points or better.

The minimum score of Firsts shall at all times be four points below the score required for Extras.

The minimum score of Seconds shall be four points below the minimum score required for Firsts.

The minimum score of Thirds shall be five points below the minimum score for Seconds.

QUANTITY

When creamery butter is offered in carlots it shall be understood to be at least 280 tubs and not over 310 tubs of the make of one creamery, unless otherwise specified.

When Packing Stock is offered in carlots it shall be understood to be at least 18,000 pounds of butter and not over 22,000 pounds, unless otherwise specified.

INSPECTION

Certificates of Inspection for "held" butter in a freezer shall be good for thirty days after issue, provided the butter remains at approximately the same temperature and in the same warehouse and has received proper care since being inspected.

SAMPLES

There shall be drawn as samples for inspection by the Inspector not less than five packages from lots less than fifty packages of one mark and invoice, and not less than ten packages from lots of fifty to two hundred packages of one mark and invoice. Where inspector is called upon to inspect lots of butter containing more than 200 packages it shall be discretionary with the Inspector as to the percentage necessary to examine in order to arrive at the correct results, but he must examine not less than five per cent.

INSPECTION BRAND

The Inspector shall brand with a rubber stamp on the top and side of each package inspected the name of the Inspector, the Exchange and the date inspected.

SHIPMENT

Prompt shipment shall be understood to mean within three days, unless longer time is specified.

(c) Laboratory Examinations. In the veterinary inspection of the finished product, samples may be retained and forwarded to a Medical Department laboratory in accordance with Army Regulations for bacteriological, chemists or other tests as required.

c. Inspections on Receipt. This is conducted whenever or wherever butter is accepted, along the same general lines as outlined under Chapter VIII, for fresh meats. Upon any receipt, butter should be fresh, sweet, of an agreeable aroma, palatable, of fine texture and grain and should not contain adulterations or debris. It should not be too salty, have excess or unauthorized coloring matters, or excess moisture, and should be free from undesirable odors, either absorbed or original. Inspection procedures as outlined for the finished product under "a" above may be given butter on receipt.

This inspection also may include such reexaminations for quality, quantity, wrappings, containers and markings as required by purchasing officers at time of delivery to the Government before final acceptance.

d. Inspections during Storage. The inspection of butter in storage is along the same general lines, where applicable, as outlined for fresh meats, Chapter VIII. During storage, butter should receive an organoleptic inspection from time to time, supplemented when necessary by Medical Department laboratory examinations (see sanitation under Chapter III).

Butter unless hermetically sealed in cans, should not be stored with aromatic or odoriferous foods or substances which are likely to impart their peculiar flavor to the butter. These materials include cheeses, paints, oils, tar, pine wood and others.

Fresh, good butter may be kept under proper chill room conditions with little deterioration up to one month. For longer storage it may be kept for a period of time at $-10°$F. (see "Storage," above). Butter subjected to high temperatures deteriorates rapidly.

e. Inspection at Issue. A careful piece inspection should be given butter at issue. (See inspection at issue of fresh meats, Chapter VIII.)

f. Action. Action with reference to butter should be along the same general lines as discussed for rendered meat products, Chapter XI, also as specially discussed above.

CHAPTER XXIII

Products Inspection (continued)

Q. CHEESE

1. *General Considerations.* Cheese is a product of milk, ripened by complex chemical changes due to the activity of many different groups of microflora.

There are more than 400 varieties of cheese produced, represented by numerous kinds, shapes, sizes, flavors and qualities. All attempts of classification are more or less unsatisfactory. Classification may be based on locality; size and shape of final package; whether soft or hard cheese, rennet or sour milk, fresh or cured, cream, whole milk, half-skim milk, skim milk, cow's milk, goat's milk, sheep's milk cheese, etc. Cured cheese may be designated according to inside or outside curing. Some of the more important cheeses are Cheddar type, brick, Swiss, Camembert, Edam, Neufchâtel, Roquefort, Limburg, cottage and others. The names "full cream" and "factory cream" used in describing cheese made from whole-milk often are misleading.

Sour milk cheeses are made by precipitating the curd of sour milk by gentle heat. The precipitate is chiefly casein. Such cheeses are always soft. Rennet cheeses are made by precipitating the curd of milk (containing less acid than that used for sour milk cheese) by means of rennet or pepsin. Their coagulum consists principally of paracasein. Such cheeses may be hard or soft.

Cheese consists principally of water, fat, protein and products of protein decomposition, and mineral matter. (See page 621.)

2. *Commercial Production.* The manufacture of the various cheeses is very complex. Whole milk, skim milk, part skim milk, enriched milk, or cream; of the cow, goat, sheep or other animal; in a sweet condition or of an acid content of 0.2 to 0.3 per cent or higher; may be heated from 70 to 96°F. for various kinds of cheese. Starter may or may not be added and the warm milk held in a vat over a period of time to gain a desired acidity. Plant juices, souring, pepsin or rennet may be employed for thickening purposes. The curd may or may not be cut, stirred, firmed, heated, freed from whey, tested for firmness

or acidity, matted, milled, salted, flavored, placed into hoops to form, then pressed; and the cheese may or may not be cured, washed, turned, paraffined, stained, varnished, dried, wrapped, canned or grated.

Composition of Cheeses
(Doane and Lawson)

KIND OF CHEESE	WATER	FAT	PROTEIN, ETC.	TOTAL ASH
Brie	50.14	24.27	18.12	4.28
Camembert	50.30	22.79	19.24	4.06
American Cheddar	34.78	31.77	28.11	3.70
Emmenthaler	34.87	28.18	30.80	5.38
Edam	36.93	26.19	27.45	5.68
American Edam	46.87	24.08	22.65	3.10
Gorgonzola	36.75	31.76	26.29	4.37
Parmesan	31.22	20.09	40.77	6.02
Roquefort	31.25	44.09	27.23	6.53
Stilton	27.02	38.61	27.15	3.47

a. American Cheese, Cheddar Type. "Cheddar" cheese was first made in a village of that name in England. The name now is applicable to the process of making, and also is used to designate one size of the cheese (14 or 16 inches in diameter and weighing from 60 to 100 pounds). Cheddar cheese is made from sweet, whole, partly skimmed or skimmed milk of cows. When made from whole milk it is called "whole milk" or "full cream," when otherwise it is termed "part skim" or "skim."

The night and morning milk may be mixed and delivered sweet to the factory. Here the odor test is given, the milk weighed and tests such as for acidity, specific gravity, fat, sediment, curd, fermentation and adulterations, made if desired. The accepted milk is strained to remove insoluble dirt, is run into a holding vat under agitation, ripened at about 86°F. spontaneously or by means of a starter to 0.19 to 0.2 per cent of acidity, authorized coloring matter added if desired, rennet or pepsin extracts added, milk stirred three to five minutes, all agitation stopped before coagulation starts, and the vat covered and left undisturbed twenty-five to thirty minutes or until ready for cutting.

After the curd is sufficiently hard it is cut to permit the escape of whey. The curd is cut into small even cubes by means of a $\frac{3}{8}$ inch wire curd knife. The pieces of curd contract or firm, the curd mass is agitated to prevent the formation of lumps or masses, and heated to from 96 to 102°F., twenty to sixty minutes to aid contraction and expulsion of the whey. When the pieces of curd have decreased to

$\frac{1}{2}$ their original size, are firm and springy and the whey contains 0.17 to 0.24 per cent acidity, the whey is removed from the curd. From the time the whey is at the curd level until removed, the curd is stirred to dry it. Next "cheddaring" is accomplished by piling or matting the curd evenly along both sides of the vat with an open channel between the masses of curd for drainage of the whey, the curd allowed to mat in a solid mass, then cut into strips or blocks 6 to 8 inches wide, turned over, allowed to drain fifteen minutes, then piled and repiled every fifteen minutes until a sufficient amount of whey has been removed and the curd shows a smooth, velvety texture and a soft, plastic body which tears apart like the cooked breast meat of a chicken.

Next the curd is milled by being cut into small, uniform pieces to facilitate salting and handling. The pieces of curd are warmed, stirred and exposed to the air for the removal of undesirable gases and flavors, piled to remove pin-holes if any, and stirred to prevent matting and until the pieces are silky, mellow and well contracted. When the whey exuding from the curd has 0.9 to 1.2 per cent acidity, the curd is spread in a thin layer in the vat, cooled to 90°F. if necessary and salted to facilitate whey removal, firming and contraction of the curd, to inhibit undesirable fermentation and to retard lactic acid formation.

Next the curd is weighed into desired amounts, placed into hoops and pressed. When the curd is firmly cemented together and the cheese is sufficiently pressed, it is removed from the hoop, dressed with a bandage and cap cloths, returned to the hoop, and pressure continued twenty-four to forty-eight hours.

When each cheese is taken from the press it is dried with a cloth, and finger marks and rust spots removed. Deep seated debris are removed with a brush and hot water. The cheese then is placed into the curing room on clean shelves, free from mold. Each day until shipment each cheese is wiped dry and free from mold, and turned. When the temperature, ventilation, and humidity of the curing room can be controlled, cheese may be cured sufficiently for shipment in ten to fourteen days. The curing room shrinkage is about 5 per cent. Cheese may be cured at temperatures from 34 to 50°F. or above. Rusty spots are the result of bacterial infection. Moldy cheese should be cleaned by brushing, scraping, washing and drying.

Cheese may be dried on the surface and dipped two to fifteen seconds in paraffin melted at a temperature of at least 220°F. This coats the cheese with a thin layer of paraffin which prevents moisture shrinkage and mold growth. About 5 or 6 ounces of paraffin are used to coat

an 80-pound cheese. When an insufficiently dried cheese is paraffined, the paraffin may break off and the surface of the cheese become wet and smeary (rind rot).

Sizes or Styles of American Cheddar Cheese

(*Van Slyke-Publow*)

Name	Shape	Approximate size	Approximate weight
		in. diameter	*pounds*
1. Cheddar or Export	Cylindrical	14–15	60–70
2. Flats or Twins	Cylindrical	14–15	30–35
3. Home-trade	Cylindrical	11–13	20–25
4. Daisies	Cylindrical	12–13	20
5. Young American	Cylindrical	7–8	8–12
6. Longhorn	Cylindrical	5	12
7. Picnic	Cylindrical	4–5	1–2
8. Square	Rectangular	Various sizes	–(3–4 in. thick)
9. Print	Rectangular	$10 \times 10 \times 2\frac{5}{8}$	10 (marked in blocks or prints)

In boxing cheese for shipment clean boxes are selected, the cheeses weighed, packed in the box using a thin piece of wood veneer called "scale board" as a liner on the bottom and top of each box. The weights are marked on the boxes. The box lids should fit snugly.

Cheese should be shipped in properly cooled refrigerator cars. They should not be allowed to freeze or be exposed to high temperatures. Cold storage may be used to preserve cheese for several months.

Many modifications of the above general process of manufacture are used. Some cheese in brick form is wrapped in metal foil and boxed for the trade, some is canned (see "f" below), while in some instances the curd after pressing is placed into a corrugated metal mold for the production of "pineapple" cheese.

Cheese containing less than 50 per cent fat in the dry matter usually is classed as skim milk cheese. In whole milk cheese the limit of moisture usually is 40 per cent or less. Federal and state cheese standards should be consulted for detailed information.

b. Swiss Cheese. In making Swiss or Emmenthal cheese the milk is strained into a kettle, heated by confined steam to from 90 to 95°F., set with lactic starter and rennet extract and the vat is covered. The curd should be thick enough to cut in twenty-five to thirty-five minutes. It is cut with a "harp" and reduced to small pieces the size of wheat

grains. When of proper fineness the curd is allowed to settle ten to fifteen minutes, the whey is drawn off, the curd continually stirred with a basket stirrer twenty-five to thirty-five minutes during which time the temperature gradually is increased to 125 to 140°F., heat discontinued and stirring continued about thirty minutes or until the curd is sufficiently dry. Cold water or cool whey is added, curd stirred briskly, allowed to settle, a cloth is slipped between the curd and kettle, the bag of curd hoisted, allowed to drain an instant, lowered into a form, pressed, and the cheese turned frequently up to twenty-four hours.

After twelve hours pressure, block curds are divided into strips 5 by 6 by 20 inches, weighing twenty pounds, and each strip is placed into a separate mold and pressed.

After twenty-four to thirty-six hours of pressing the cheese is placed into a salting room and dry salted or immersed in a brine tank, and turned each day for two to six days. The cheese then is placed on clean, dry shelves in a curing room where it is washed, rubbed, salted and turned each day. In the curing room the humidity and temperature are controlled so that in ten to twelve weeks there is a proper development of "eyes" without undue fermentation. The temperature may vary from 60 to 70°F.

When the eyes are properly developed, the cheese is placed into storage at a lower temperature (50 to 55°F.) and the salting and turning continued until no more salt is absorbed freely ("salt ripe").

c. Edam Cheese. In making this kind of cheese, fresh, partly skimmed milk, free from taint, is heated to from 80 to 85°F., cheese color added, stirred, rennet extract added, milk coagulated in twelve to eighteen minutes, curd cut into very small pieces, well firmed in the whey, the whey withdrawn, curd well stirred in the vat, salted in the granular form, filled at 88°F. into cast iron spherical molds lined with cheese cloth, pressed at least thirty minutes, the cheese removed from the molds, rough places trimmed off, immersed two minutes in hot whey at 125°F., wrapped in strips of cheese cloth, returned to the molds and pressed about twelve hours.

The cheese then is dry or wet salted in the molds with turning for four or five days, then washed with whey, wiped dry and placed into a moist curing room at 60 to 65°F., and turned daily. When about two months old the surface is dried, immersed one minute in a solution of carmine or other suitable red dye and drained. When dry, the outside is rubbed with boiled linseed oil and the cheese is wrapped in

tin foil or is paraffined. Finished cheeses are packed in boxes for shipment.

d. Camembert Cheese. This is a soft, ripened rennet cheese made in a room at 60 to 70°F. Milk in good condition, at 85°F. is ripened with a starter to an acidity of 0.2 to 0.23 per cent, rennet extract is added, the curd is cut in about one and one-half hours or without cutting it is dipped into the hoops which are placed on mats on a draining board and table. In eighteen hours the curd should have contracted to a thickness less than 2 inches. The cheese may be inoculated, salted on one side and turned. In twelve hours the cheese may be turned and the other side salted. The cheeses are held on salting boards three days, then placed into a moist curing room at 52 to 58°F., spaced for good air circulation, and held about three to four weeks.

During this time Penicillium camemberti grows on the cheese, certain bacteria and yeasts develop, the cheese softens and there is a loss of moisture so that the fully ripened cheese contains about 50 per cent of moisture. A ripened cheese has a thick rind; a creamy, almost fluid consistency in the interior; is waxy; yellowish in color; and the ripened curd is alkaline to litmus. In addition to the growth of mold, other organisms develop so that the finished cheese has a reddish appearance. The ripened cheeses are wrapped in tin foil or parchment paper and packed in boxes.

e. Pimiento Cheese. This is American Cheddar cheese having canned pimiento (a sweet pepper) added to the curd after salting so that a red color is distributed unevenly throughout and the pimiento flavor can be detected in all parts of the finished cheese.

f. Canned Cheese. Various methods are used to can fresh curd as well as finished cheese in an unsterile or in a sterile condition. One method consists of selecting old cheeses, removing the soiled rinds with their contained mold, and cutting the cheese by means of a wire into suitable chunks. These pieces are mixed with similar chunks of fresh cheese, then shredded, melted in a steam heated hopper under agitation and filled into clean, dry, labeled cans which are lined with parchment liners. The cans are sealed and processed in retorts, cooled, and packed in cases.

3. Veterinary Examinations. The scope of the veterinary examination of cheese is similar to that of butter (See Chapter XXII).

a. Inspection Prior to Purchase. (1) Preparation. The veterinary inspection of cheese prior to purchase includes the same sanitary requirements as for butter. A sanitary examination should be given

the establishment, equipment and personnel, and a supervisory inspection made of ingredients used and all processes and methods employed in handling the starter, rennet or pepsin extracts, and special cultures; ripening the milk, the cutting, draining, working, molding, salting, curing, storage, and the boxing of the finished product; shipment or other manipulation.

A correct opinion can hardly be formed regarding the fitness of cheese for consumption merely by an organoleptic inspection of ingredients used or of the finished product. Bacteria and other microflora of cheese originate from the milk, water, rennet or pepsin extracts, starter, cultures, air, utensils and employes. Disease-producing germs as B. tuberculosis, hemolytic streptococci and others may occur in the milk and be found in finished cheese. Mohler stated that the germs of tuberculosis were found in Cheddar cheese when four months old. During the World War, hemolytic streptococci were found present in Cheddar cheese in one Army camp, necessitating active sanitary measures. There is danger in eating cottage and fresh cream cheese from milk of questionable origin. Adequate veterinary dairy farm inspection as outlined under Chapter XVII, the sanitary supervision of the milk to the factory and its efficient pasteurization, therefore, are desirable for this class of cheeses intended for troops. Poisoning through ingestion of cheese has been reported. In some cases the poison was ascribed to organisms responsible for diarrhea in cows and which gained access to the milk, thence to the cheese. Usually, however, in cheese subjected to a long period of ripening, the pathogenic bacteria do not survive. Whenever necessary prior to purchase, samples of ingredients entering into cheese or of the finished product, should be retained and forwarded to a Medical Department laboratory for examination in compliance with Army Regulations.

(2) Inspection of the Finished Product. Cheese for the Army should be sound, typical of the class to which it belongs, uniform in its various characteristics of style, size, weight, package, hole formation, color, flavor, texture, body, etc., and should comply with purchase requirements which should be consulted. A cheese trier, 5 to 6 inches in length, semicircular in shape, $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter, with sharp edges and point and a suitable handle may be used to determine the condition of the interior of the cheese.

(a) Selection of Samples. Sample packages of cheese to be examined should be selected by the veterinarian in such a manner that they will be representative of each lot covered by the same transportation

number and the same consignor's mark. When the factory vat number is not indicated on the package, selection should be made about as follows: in a lot of 25 packages, 5 sample packages should be drawn and examined; in a lot of 50 packages, 8 samples; in a lot of 100, 10 samples; in a lot of 150, 15 samples; in a lot of 200, 17 samples; in a lot of 250, 20 samples; and in lots above 250 packages, 5 sample packages for each additional 100 packages or fraction thereof. When separate vat numbers are present on the package, one package of each separate vat should be examined. When not enclosed in a container, each individual cheese is considered a package. In any event, the veterinarian may examine a greater number of packages of cheese than is indicated above, or even make a piece inspection with a trier, in addition to Medical Department laboratory examinations when necessary, to determine soundness, compliance with specifications or to establish properly the grade and score.

(b) Whole Milk, American Cheddar Cheese. Cheddar type of cheese may be classified according to the milk used as "whole milk," "part skimmed" or "skim" cheese and according to package or style as "cheddar," "flats" (single or twin), "daisy" (single, double or triple), young americas, long horns, lunch, squares, pineapple, pimiento, canned, etc. Whole milk, American Cheddar cheese packed in wooden cheese boxes may further be classified according to ripeness, age or degree of flavor; the degree of color; and the degree of firmness and character of texture. "Fresh" cheese is newly made and shows no curing or ripening. "Mild" cheese is partially ripened or cured and has a mild flavor. "Aged" cheese is fully ripened or cured and has a pronounced flavor. A "firm close" cheese is compact, firm and practically free from openings. A "medium close" cheese is moderately compact and firm with a few mechanical openings. A "medium open" cheese is one that gives a somewhat soft but not pasty plug, and which shows large or many openings. An "open" cheese gives a soft, pasty plug, has an open texture and is placed into second grade. An "uncolored" cheese is as the name indicates. A "medium colored" cheese is of a deep, straw shade or lighter in color. A "high colored" cheese has a reddish or extremely pronounced color.

Score Card. One standard score card applicable to whole milk cheddar cheese allows the following maximum perfect scores: Body and Texture 40, Flavor 30, Finish and Appearance 20, Color 10 and Total 100 points.

Routine of Inspection. The requirements for the inspection room and sanitary sampling as discussed for butter, Chapter XXII, are applicable for the inspection of cheese.

Package. The markings on the package should be noted. Containers should be of uniform, proper size, well made, substantial, sound, fairly close fitting and clean. The insides of the lid and containers and the scale boards should be free from mold and contaminations. Note if the cheese is paraffined or not paraffined, the presence of cracked paraffin and rind rot. The bandage should be clean, properly placed, close fitting, smooth, dry and neatly rounded over the edges. Bandage defects include tears, wrinkles, looseness, too long or too short at one end, misshapen or poorly placed. The cheese should be neat, clean, smooth, attractive, with a square even edge, straight sides, and of uniform height. The rind should be firm, smooth, of even color and free from cracks. Imperfections and unsoundnesses include cheese mite or skipper infestation, mold, rust spots, spoiled or soft places, dirt, evidence of rat, mice or other contaminations, moldy trier holes, light spots, roughness, bulging ends or side, undersized, uneven in size, uneven surface or edges, high or crooked edges; greasy, cracked or improperly closed rinds; cracked cheese or holes.

Body and Texture. The cheese trier should be inserted in a slanting manner into the top of cheese, directed toward its center, turned around, and withdrawn, removing a cylindrical plug of cheese. When inserting the trier, old trier holes should be avoided and consideration given spoiled, moldy, soft or watery places in the cheese. Samples may vary in different parts of the same cheese.

As soon as the plug is removed, it should be passed quickly under the nose to detect any volatile odors.

Body refers to the degree of firmness of the cheese as a whole, texture to arrangement of the parts and the character of the openings as to nature, distribution, size and shape.

The nature of the body characteristics, whether firm, solid, medium firm, hard, soft, watery, silky, waxy, smooth, corky, gritty, lumpy, mealy, or crumbly, dry, weak, greasy, salvy, pasty or curdy, can be determined by working and rubbing a sample of the cheese in the hand or between the thumb and fingers for a few minutes. The body should be smooth, silky, waxy and firm.

The texture may be close, medium close, medium open or open.

A perfectly close, compact, firm bodied cheese will draw a solid or candle plug. Such a cheese may contain a slight number of irregular,

mechanical openings due to mechanical conditions obtaining during matting and pressing the curd. These openings have little bearing on the quality or flavor of the cheese. A plug from a well made cheese sometimes can be bent in a half-circle without breaking. It breaks gradually and shows a torn surface, meaty or fibrous texture, and when held before the light has a color slightly translucent like amber, whether the cheese is colored or not. Cheese which is mealy or brittle, breaks suddenly, is inelastic and will not bend. This condition generally is due to too much acid, in which case it has a dead, white, chalky or faded color and a strong acid or sour flavor. A cheese may be dry, hard, stiff, firm, corky, or rubbery when it is overfirm, hard, tough, not pliable, does not mould waxy or does not readily break down in the hand.

An acid cheese may appear mealy, crumbly, faded and sour to the taste, or may be pasty, soft and sticky, sometimes caused by too much moisture. A weak cheese may be close boring, yet soggy; usually appears in cold weather and with increased richness of milk. Greasy cheese is indicated by free butter fat between particles of curd which are not cemented together.

A cheese with a medium firm body, and a few mechanical holes or openings is said to have a medium close texture. Such a cheese is velvety, smooth, silky, waxy, pliable and slightly translucent.

A soft bodied cheese, having numerous mechanical openings, drawing a complete plug, yet free from a salvy or pasty condition, is said to have a medium open texture. Should soft cheese adhere to the hand in rubbing or to the trier, it is termed "pasty" or "salvy."

Loose or open cheese, filled with irregular-shaped holes, usually is too soft and weak-bodied to draw a full plug. Such cheese is defective in texture and is placed in the second or off grade.

A gassy textured cheese is spongy with a large number of very small, round "pin holes," slightly flattened "fish-eye" openings, or larger "Swiss" holes throughout. These openings are regular, smooth and glossy. A "buffed" or bloated cheese has distended sides or ends. A "stinker" is a very gassy cheese having a very offensive odor. The cheese may puff up, have rounded edges, assume a somewhat spherical form and crack or break open. This may be due to certain microorganisms gaining entrance through unclean handling or dirty milk. A gassy condition indicates poor quality.

About one inch of the outer end of the plug should be replaced into the trier hole to prevent molds or insects entering the cheese, and the remainder of the plug saved for further examination.

Color. A maximum rating is given uncolored or a uniform, even, slightly translucent medium colored cheese, while a high reddish color would place a cheese in second grade. An uncolored cheese is light amber in color. Color defects include white specks, streaked color, wavy color, mottled color, seamy, high color, rust spots, mold, "acid cut" or faded and uneven colors. A mottled cheese has variegated markings or a spotted, uneven color, and is most noticeable in colored cheeses. In a seamy cheese, the outline of each piece of curd may be seen.

Flavor. Cheese is seldom tasted to detect flavor. After tasting five or six samples, the sense of taste usually fails to differentiate further. As a rule, a bitter flavor cannot be detected by the nose, but must be tasted; almost any other defect in flavor can be observed by smelling. The character of the aroma is noted as the plug is drawn, later part of the plug should be kneaded in the hand and the odor noticed. When cheese is mixed and thoroughly warmed, the odor becomes more pronounced.

The character of the flavor and aroma is indicative of the quality of the raw materials used, methods of manufacture, stage of ripening, storage conditions and quality of the finished product. The general appearance, nature and character of the body and texture and especially gas-holes, should be noted in connection with flavor.

A fresh cheese has a raw-curd flavor, a moderately ripened cheese a nutty or mild flavor and a well ripened cheese with considerable age, a somewhat sharp, well developed flavor and aroma. The degree of flavor resulting from curing is only considered in classifying a cheese and is not used in rating flavor on the score card.

"Pleasing," "desirable" and "poor" flavors indicative of quality, are considered in rating cheeses. Pleasing flavors, common to cheese scoring 92 or above, are clean, agreeable, palatable flavors of highest quality. Flavors somewhat lacking in some of the finer characteristics, but suggestive of taints yet not disagreeable are called "Desirable." These flavors are common to cheese scoring 87 to 91 points. "Desirable" flavors as defined, include those due to feed, as turnip, cabbage, decayed ensilage, frosted feed, certain weeds or green feeds; those absorbed by milk from unclean stables as "barny" or "cowy"; yeasty or fruity aromas from unclean cans, indicated by a fermented-whey or a fruit odor and somewhat "sick" flavor; acidy, bitter, or fishy.

Poor, off or disagreeable flavors, such as of old milk, dirt, unclean, stale, stable, sour, rank-bitter and rancid, are common to low quality

cheese scoring less than 87 points. A gassy cheese frequently is "rank-bitter." A rancid flavor is indicative of the lowest quality.

After scoring a cheese, the trier should be cleaned thoroughly.

Definition of Scores. Whole milk, American Cheddar type cheese may be graded as "Fancy," "Grade 1," and "Grade 2."

The fancy grade, scoring 92 or more points is characterized by a good body in fresh cheese, smooth body in aged cheese; a close or medium close texture without openings due to gas; a clean, agreeable flavor in fresh cheese or a particularly palatable and pleasing aroma and flavor in a well cured cheese; of uniform size; ideal shape; square edges, straight sides and smooth; a dry closed rind free from checks, cracks or other imperfections of finish or appearance and free from rust spots, cheese mites, skippers, mold or other unsoundness; and the cheese may be uncolored or of a uniform, medium color and slightly translucent.

Grade 1, scoring 87 to 91 inclusive is characterized by drawing a full plug practically free from gas-openings, may have mechanical openings; a reasonably good body in a fresh cheese or a smooth and quite meaty body in a well cured cheese; a close, medium close or medium open texture, and must be a good, desirable cheese; a reasonably clean flavor and aroma, or lacking in flavor; with square edges, straight sides, dry closed rind, clean, reasonably uniform in finish and appearance, and free from cheese mites, skippers, rust spots and other unsoundnesses except that it may contain a small amount of mold; and the cheese may be uncolored or a fairly uniform medium color free from mottles.

Grade 2, scoring 86 or below, includes all cheese not good enough for Grade 1 and may show any of the following characteristics: the body and texture may be close, medium close, medium open, gassy, very defective, pasty, soft, crumbly, high acid, short, tough and very weak; the flavor may be rank-bitter, rancid, sour, dirty, unclean or otherwise poor; the finish and appearance may be "buffed," misshaped, watery, soft or show rot spots, badly cracked or otherwise very defective; and the color may be very irregular, mottled, wavy, streaked or extremely high.

In inspecting American Cheddar cheese prior to purchase the purchase requirements should be consulted by the veterinarian. For the Army, irrespective of the score, unsound or insanitary cheese or that of questionable origin should be rejected.

(c) Other Cheeses. *Swiss Cheese.* Swiss or Emmenthal cheese intended for the Army should satisfy all the sanitary and purchase requirements. The Wisconsin score card for Swiss cheese is: Flavor 35, holes 30, texture 20, salt 10 and package 5. Commercially, Swiss cheese is graded according to eyes and flavor. The flavor being equal, the grades are "fancy large eyed," "well eyed," "medium eyed," "small eyed" and "blind." Imported Swiss cheese is inelastic, hard, whitish and short but well cured and salted. The domestic Swiss cheese frequently is sold uncured, being elastic, rubbery, yellowish and lacking in salt and cured flavor.

No. 1 Swiss cheese as marketed has evenly distributed eyes of good size, a doughy texture and good flavor and saltiness; No. 2 Swiss cheese includes blind, niszler, glass or those with abnormal or uneven eyes; while No. 3 Swiss cheese include those with decayed spots, puffed cheese, surface openings caused by rats or mice, or cheese otherwise unsound.

A cheese which does not develop eyes, due to improper manufacture, lack of propionic acid-producing or other desirable organisms, being too dry, or curing at too low a temperature, is called, "Blind." Niszler cheese is Swiss cheese that contains numerous small gas holes due to dirty milk. Glaesler or "glass" Swiss cheese shows horizontal clefts or cracks instead of eyes. This may be due to a variety of conditions during manufacture. "Blown" Swiss cheese due to fermentation, develops too large eyes, which become confluent, forming large cavities, and frequently split the rind.

Camembert Cheese. One War Department specification for Camembert cheese, August 26, 1920 is quoted in part as follows, however the current specifications should be consulted:

> To be made from cow's milk from which not more than one-half of 1 per cent of butter fat has been removed. To be best commercial grade. To contain not less than 25 per cent of butter fat and not more than 49 per cent of moisture, and to conform to the Standards of Purity established by the United States Department of Agriculture.

In Camembert cheese the Penicillium camemberti mold causes texture changes, while red slime-forming bacteria and Oidium lactis produce flavors, therefore red slime is a criterion of good quality in this kind of cheese. A bluish-green layer of mold indicates cheese of poor quality.

Edam Cheese. One Army specification for Edam cheese under date of June 9, 1921, is quoted in part as follows, however the current specifications should be consulted:

> To be No. 1, Edam cheese. The flavor to be clean, mild, nutty, and pleasantly saline; the texture and body to be firm, close, and mealy; to be well made and cured; and to contain not less than 24 per cent butter fat and not more than 38 per cent of moisture.

The body of an Edam cheese should be solid, quite dry and crumbly, the texture should be close and free from openings, and the flavor should be clean, mild and pleasantly salty and not sour or offensive.

Pimiento Cheese. One Army specification under date of August 15, 1921 in part required pimiento cheese to be made of No. 1 Cheddar cheese and "first quality sound ripe red peppers known as pimentos or pimientos, free from seeds and stems. The finished product to contain not more than 42 per cent of moisture and not less than 30 per cent of butter fat. The ingredients and finished product to conform to the Standards of Purity established by the Department of Agriculture. To be purchased on sample."

Canned Cheese. The inspection of canned cheese should be along the same general lines as discussed for canned meats, Chapter X. Purchase requirements also should be consulted.

b. Inspections on Receipt, during Storage and at Issue. These in general are along the same lines where applicable as discussed under fresh meats, Chapter VIII. The inspection procedures, as outlined in "a" above may serve as a guide. Cheese readily absorbs foreign flavors and odors and therefore should be stored separate from volatile or odoriferous substances. Canned cheese may be inspected along the same general lines as discussed under canned meats, Chapter X.

c. Action. (See "Action," Chapter VIII.) Cheeses should be rejected when rancid, tainted, contaminated, "puffed up" due to bacterial invasion, mouldy, (when not characteristic), infested with parasites or otherwise unsound; when undesirable ingredients are used in their manufacture, including infected or contaminated milk, adulterants and unauthorized coloring matters, and when not up to specifications.

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